PHYSICAL AND MEDICAL CLIMATE

AND

METEOROLOGY

OF THE

WEST COAST OF AFRICA

WITH

VALUABLE HINTS TO EUROPEANS FOR THE PRESERVATION OF HEALTH IN THE TROPICS.

BY

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TO THE

RIGHT HONOURABLE EDWARD CARDWELL,

M.P., D.C.L.,

LATE SECRETARY OF STATE FOR THE COLONIES,

ETC. ETC. ETC.,

THESE PAGES,

AS A TRIBUTE TO HIS PUBLIC ENDEAVOURS TOWARDS THE MATERIAL

ADVANCEMENT OF THE AFRICAN RACE,

ARE INSCRIBED,

BY HIS OBEDIENT SERVANT,

THE AUTHOR.

TO

THE PRESIDENT AND MEMBERS OF THE EXECUTIVE AND LEGISLATIVE COUNCIL OF THE CENTRAL GOVERNMENT OF WESTERN AFRICA.

Gentlemen,—It has been truly remarked by Heberden, that one of the first steps towards preserving the health of our fellow-creatures is to point out the sources from which diseases are to be apprehended. I have therefore, in the pages of this work, endeavoured to investigate that subject in its detail, and to point out the various causes which, on the West Coast of Africa, have led to so fatal a result among the European and native population; which have degraded the lives of a great many; and which have deteriorated the energies of the inhabitants.

The maladies peculiar to tropical climates have the most mischievous effect in checking the progress of true civilisation in tropical countries; they leave a prestige of insalubrity hanging like a cloud over them. How far this is the case in Western intertropical Africa, I need not venture to enlarge upon, but will merely remark in passing, that not only has the European on leaving home a melancholy foreboding of a speedy termination of his existence, but his relatives and friends also reckon him, from the day of his embarkation, as amongst the dead; and to what extent these forebodings have been realised, I leave the death-rate of the few Europeans who visit the coast to tell.

It is unfortunately true, that the actual approach of disease is the only mighty stimulus which can induce men in power to give sufficient attention to sanitary matters; and the *Saturday Review* has but recently made this just remark, that "when the public health is satisfactory, sanitary reform is naturally (held to be) rather a dull subject, and sanitary reformers run the risk of being voted at least equal nuisances with the abuses which they wish to get removed." But the public health is never satisfactory in the British colony in Western Africa. In a pamphlet lately published by me on the "*Political Economy and Requirements of British Western Africa*," I urged the necessity of sanitary reform on the coast, and I was harshly remarked upon by many of those whose lives it was my chief object to spare. In this present work I have entered more into detail respecting the nuisances which abound in the various colonies, and I must, therefore, be prepared for still harsher comments.

But believing that you, gentlemen, like myself, are interested in the material advancement of the inhabitants of the coast, and are ready to become "ministers, under Divine power and goodness, in prolonging and economising the life of men,"—that any means by which the great mortality could be effectually diminished would be welcomed by you,—and that gradual and efficient remedies would willingly be adopted by you to remove the evils pointed out, I beg respectfully to submit for your attention and consideration the detailed causes of the diseases of the coast, and the prophylactic measures which are necessary for their amelioration.

In conclusion, may I be allowed to state that it will be a happy day for the West Coast of Africa, for its European inhabitants, and for its native population, when the Governor-General may be able to state authoritatively, that "my medical

officers of health* are industriously mapping out the realms of diseases which too often definitely manifest themselves amongst the vilest purlieus of our colonies, and ere long Western Africa will, I trust, be pronounced one of the healthiest of Her Majesty's intertropical possessions, since many of the causes of disease are being systematically, energetically, and effectually exterminated by rigid sanitary reform."

I have the honour to be,

GENTLEMEN,

Your most obedient humble servant,

AFRICANUS HORTON, M.D.,
Staff Assistant-Surgeon.

CAPE ST MARY'S, BATHURST, GAMBIA,
26*th September* 1866.

* Since the distribution of the circular announcing the intended publication of this volume, and while it has been passing through the press, the Local Government of Sierra Leone have promulgated an ordinance for establishing a Board of Health there.—The EDITOR.

PREFACE.

WHILST the physical and medical climate of India, Ceylon, the West Indies, Australia, and Intertropical United States, has been ably described by Carter, Sir R. Marten, Norman Chevers, Miss Nightingale, Sir E. Tennant, Robert Jackson, Burgess, and Blodget, there has never appeared a work on that of Western Africa, as a whole, which would present an easy reference on the various interesting subjects involved. There are several works on the physical geography of Western Africa, such as that of Hutchinson, Poole, Burton, &c., and recently Dr Clark has published a most able topographical description of the Gold Coast.

It has become a bye-word amongst Europeans that the Western African colonies are the most deadly of the British possessions; but what are the various causes which have led to this result, and what hygienic means are necessary for their prevention and removal, are subjects which have not received detailed consideration.

It is for the purpose of supplying this desideratum

that I have ventured to undertake the publication of the following researches made by me during a period of six years on the West Coast of Africa; and although I am conscious that in the execution of my task I have committed "many sins of omission and commission," yet I still venture to hope that the inferences and deductions drawn from the various observations on the subjects treated of, may serve as a guide to those who shall hereafter attempt to give a fuller consideration to the subject.

My opportunities of observation have been such as to enable me, from personal experience, to make accurate statements with regard to the climate from the Bight of Benin to Senegal. I was stationed for nearly a year at Quittah, in the Bights, and visited Lagos. I served from time to time, during several years, at all the military posts on the Gold Coast. I am a native of Sierra Leone, where, fifteen years ago, I made thermometrical and pluviametrical observations; and I was for two years and a half stationed in the interior and on the sea coast of the Gambia, the climate of which is almost identical with that of Senegal on the north, and the Casamanza on the south.

The plan adopted in this work is that recommended by Malte Brun, and improved by Martin. I first considered the *physical climate* and *meteorology*, including the *seasons;* then the *medical climate*, with the *mortality;*

and I close with some *hints for the preservation of health in the tropics.*

I have received great assistance from the able work of Sir Ranald Martin, on "The Influence of Tropical Climate;" of Dr Edmund A. Parkes, on "Practical Hygiene;" and of Dr James H. Pickford, on "Hygiene."

JAS. AFRICANUS B. HORTON, M.D.

CAPE ST MARY'S, RIVER GAMBIA,
WEST COAST OF AFRICA, *October* 1866.

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PHYSICAL CLIMATE AND METEOROLOGY

OF

WESTERN AFRICA.

CHAPTER I.

INTRODUCTION.

By the term climate is to be understood the condition of a place as regards the various complex phenomena connected with the soil, the water, and the atmosphere. Definitions. Climate.

When soil is referred to in a climatic point of view, it is intended to include all that portion of the earth's crust which, under certain conditions, is capable of affecting health. Soil.

Dr Parkes gives the four following as the conditions necessary for soil to affect health, viz.:—

1. Its conformation and elevation.
2. The vegetation covering it.
3. Its mechanical structure, which influences absorption and radiation of heat, reflection of light, absorption of water, movement of water over and through the soil, passage of air through soil, formation of dust.
4. Its chemical structure, which acts especially by altering the composition of the air over the soil, or the water running through it.

To which may be added the aspect of a place, and the amount of sunshine and light it receives.

There are only two considerations by which the supply of water might affect health, viz., its quality and its quantity. Water.

The climatic conditions of the air or atmosphere by which Atmosphere.

health can be affected might be arranged under the following headings, viz.:—1. Its temperature; 2. Its humidity; 3. Its movement; 4. Its weight; 5. Its composition; and 6. Its electrical condition.

Meteorology. Of late, the meteorology of tropical climates has occupied the attention of many physicians; and the more our knowledge is increased as to its various influences in enhancing or mitigating diseases, the better shall we be able to conquer many seeming difficulties in their treatment. Unfortunately, as yet meteorology has not been turned to extensive practical advantage; but every year new facts are discovered, and old principles greatly elucidated; and the time is not far distant when the ascertained meteoric causes of disease will be so displayed before the public mind, that each individual will, by the force of public opinion, find it incumbent on him to employ the best hygienic remedies for the removal of those causes.

I differ from the assertion of Dr Mason Good, that "of all the subdivisions of general philosophy, meteorology is the least entitled to the name of science; and, consequently, physicians need not blush at being incapable of turning to account the supposed influence of the planets, or of unfolding and tracing the origin and capricious courses of epidemics and pestilence." This subject opens a wide field for investigation, which would repay any physician who labours to develope the untold facts connected with the meteoric origin and progress of pestilential and other diseases. Meteorology treats especially of the atmosphere —the different changes it undergoes during the course of the year characterised as the seasons—the degree of heat and cold —of saturation and of the state of the wind, as well as the barometric pressure, and, consequently, treats of subjects which are the ascertained causes of most of the discases we meet with in tropical climates. In these several bearings it affords objects of interest to the agriculturist, the botanist, the naturalist, the navigator, and the physician.

Meteorological Instruments. To carry on meteorological observations, various instruments are required; and I shall here give the official instructions

issued by the Army Medical Department for reading the meteorological instruments supplied by that Department. They are as follow :—

The observer should make himself thoroughly acquainted with the scale of every instrument, especially with that of the barometer, and its attached vernier, and by frequent comparisons ascertain that he and his deputy read the instruments alike, and record the observations accurately.

All observations must be recorded exactly as read. The corrections are to be made only at the end of each month on the "means" of the "sums."

Barometrical observations must be recorded to the third decimal place; thermometrical, to the first decimal. When the readings are exactly to the inch or degree, the places for the decimals must be filled up with ciphers.

The observations should be made as quickly as possible, consistently with perfect accuracy, and the observer must avoid breathing on the instruments, particularly the dry and wet bulbs, and maximum thermometers.

Barometer Readings.—Note the temperature of attached thermometer in degrees only; by means of the thumb-screw at the bottom adjust the mercury in the cistern to its proper level, the point of the ivory cone, which should just touch the mercury without breaking the surface; then bring the zero line of the vernier to the level of the apex of the column of mercury, and read off in the manner described at page 15 and 16 of Sir H. James's "Book of Instructions."

Thermometer Readings.—The scales are divided to degrees only, but these are so open that the readings can be determined to the tenth of a degree. Practice and attention will ensure accuracy.

Maximum Thermometer in Shade.—The maximum thermometer must be hung at such a distance (2 or 3 inches) from the water vessel of the wet bulb thermometer, that its readings may not be affected by evaporation.

In hanging the maximum, care must be taken that the end

of the tube is slightly inclined downwards, which will have the effect of assisting in preventing the return of any portion of the column of mercury in the bulb on a decrease of temperature. To read the instrument, gently elevate the end furthest from the bulb to an angle of about 45°, in which position of the instrument note the readings. To read the thermometer, a gentle shake or swing, or a tap on the wooden frame of the instrument, will cause the excess of mercury to return to the bulb, and it is again ready for use.

Maximum in Sun's Rays, or the Vacuum Solar Radiation Thermometer.—Being constructed on the same principle as the last mentioned instrument, it must be read in a similar position. After completing the reading, by giving the instrument a slight shake, with the bulb still inclined downwards, the excess of mercury will return to the bulb, and the thermometer be ready for the next observation.

Minimum Thermometer in Shade.—The minimum thermometer must be so hung that the bulb may be almost an inch lower than the other extremity of the instrument, because in its position the index is less likely to be affected by a rise in the temperature. The extremity of the index furthest from the bulb shows the lowest degree to which the spirit has fallen since last observation. The reading on the scale corresponding to this is the temperature to be recorded. Then, by elevating the bulb, the index will float towards the end of the spirit. When it has *nearly arrived at that point* the instrument is reset.

Minimum on Grass or Terrestrial Radiation Thermometer is constructed like the last, and the directions above given are also applicable to it.

After reading and resetting the self-registering thermometers, compare them with the dry bulb thermometer in order to ascertain that their readings are nearly the same.

Dry and Wet Bulb Thermometers.—Bring the eye on a level with the top of the mercury in the tube of the dry bulb thermometer, and take the reading, then complete the observation by taking in like manner the reading of the wet bulb thermometer.

The temperature of the air is given by the former, that of evaporation by the latter; from these data the hygrometrical results are to be calculated by Glaisher's Tables, third edition.

Rain Gauge and Measure.—Pour the contents of the gauge into any convenient vessel with a lip, and from this into the glass measure, which has been graduated especially for the gauge, and is only to be used in measuring its contents. It is graduated to the hundredth of an inch.

Anemometer.—The dials are read from left to right. The first on the left records hundreds of miles, the second tens, the third miles, the fourth tenths of a mile, and the fifth hundredths of a mile.

The reading of the anemometer is obtained by deducting from the amount registered by the dials the total sum registered at the period of the preceding observation. The difference between these (subject to a small correction) indicates the velocity or horizontal movement of the first set up; the reading on the dials must be noted, in order that it may be deducted from the total registered by the dials at the end of the first period of observation.

In making observations on the presence of ozone a box has been found to be unnecessary,—equally satisfactory results having been obtained by fixing the paper immediately under the pent-house of the stand, which shelters it sufficiently from a strong light, while it secures proper exposure.

The minimum thermometers are liable to get out of order—first, by carriage, when the index may be wholly or partly driven out of the spirit, or a portion of spirit may become detached from the main column; and secondly, by slow evaporation of the spirit, which, rising in the tube, condenses at the upper end. The first mentioned errors are corrected by taking the thermometer in hand, with its bulb downwards, and giving it a swing up and down. The second is remedied by the inclined position of the instrument, which allows the condensed spirit to trickle back to the main column.

Nota Bene.—On no account whatever is artificial heat to be

applied to a spirit thermometer. In resetting the minimum, the index should never be brought quite to the end of the column of spirit.

Observations taken by author on the coast.

Not being supplied with instruments for observation by the Government, and being subject to the various movements to which an assistant surgeon serving in such an unlucky climate is liable, the various observations which I privately registered within six years are—thermometer, hydrometer, saturation of the atmosphere, dew-point, amount of cloud, oxonometer and the weather, barometer and pluviameter.

Thermometer

THERMOMETER.—I made observations with the wet and dry bulb thermometers as well as with the common thermometer; the readings were taken at 7 A.M., 12 noon, and 4 P.M. The maximum, medium, and minimum of each month are recorded.

Hygrometer.

HYGROMETER shows the amount of watery vapour or humidity in the atmosphere at the time of the observation; this I obtain by the readings of the dry and wet bulb thermometers.

Saturation of the atmosphere.

SATURATION OF THE ATMOSPHERE.—In this observation I have endeavoured to show the degree of atmospheric saturation at the time of registering; the calculation is based on the ascertained fact, that when a space charged with the maximum of vapour is reduced in temperature a deposit of moisture in the liquid form is the result, since "the tension of vapour in every liquid remains constant for each degree of temperature, and diminishes according to the terms of a *geometric* progression; as the temperature falls in *arithmetic* progression, the elasticity of vapour falls with a fall of temperature more rapidly in proportion than the temperature declines."

Method of finding saturation of atmosphere.

The quantity of moisture contained in the air at any given time might be ascertained by first determining the temperature at which dew begins to fall, and then finding the tension or elastic force of aqueous vapour at the same period. To carry this into effect, we call the quantity of invisible vapour which it is possible for the air to retain at the temperature of observation 1000, and then make our calculation from the observed

dew-point, the proportion which the amount actually present bears to that which exists at that temperature.

Thus, on the 1st of May 1860, at Quitah, on the Slave Coast, the temperature of the air at 7 A.M. was 78° F.; the temperature at which dew began to form was ascertained to be 72°. Referring to Mr Dalton's Tables, we find that the tension or elastic force of aqueous vapour in an inch of mercury at 78° is 0·940, while at 72° it is only equal to 0·721. It is a known fact that the quantity of aqueous vapour is directly proportioned to its tension or elastic force, consequently—

$$0{\cdot}940 : 0{\cdot}721 :: 1000 : 767{\cdot}0.$$

The resultant 767·0 represents the degree of saturation at 7 o'clock in the morning of that day.

DEW-POINT.—By the term dew-point is meant that state or temperature of the atmosphere at which its aqueous vapour becomes condensed and deposited in minute drops on any surface. This temperature must, of course, have been cooled down below the point of maximum density of watery vapour. After sunset, and the temperature of the upper strata of air is much cooled down, the earth gives out its superfluous temperature into the surrounding space by radiation, and consequently cools down the air immediately in contact with it below the point of saturation; a portion of the aqueous vapour suspended in it is then deposited in the form of dew. A simple example of the result of this radiation might be adduced, by bringing a tube containing cold water into a warm room; the outside of the glass at once becomes bedewed with moisture. Dew-point definition.

To determine the dew-point, several instruments have been recommended, such, for instance, as *Daniell's dew-point hygrometer* and *the wet bulb hygrometer*, but I employed for my observation Mason's hygrometer—an instrument consisting of two delicate thermometers, of nearly equal size, the bulb of one of which is covered with thin muslin, kept always moist by the capillary attraction of a few cotton threads deprived of fat, from a fountain of water attached to it. Instrument.

To find out the dew-point, or the temperature at which dew falls, it will be necessary to multiply the difference between the temperature of the dry and wet bulb thermometers by a factor corresponding to the temperature of the atmosphere, as shown by the dry bulb thermometer, from which subtract the product, which is the *depression of the dew-point.* The resultant or remainder represents the temperature of the *dew-point.* Mr Glaisher and Dr Apjohn have calculated these factors for deducing the dew-point from the atmospheric temperature and evaporation, which are to be found in the Greenwich Magnetical and Meteorological Observations for 1844. In this treatise I have used Mr Glaisher's figures.

E.g.—On the 19th May 1860 the dry bulb of the hygrometer was registered by me at 85°, and the wet bulb at 76°, the difference being 9°; the factor, on referring to Mr Glaisher's Table, is 1°·7, which gives the *depression of dew-point* when multiplied by the difference 9°, viz., 15°·3. Subtracting this from the temperature, as indicated by the dry bulb, 85°, gives 79°·7, which is the temperature at which dew falls, or *dew-point.*

Radiation from the earth's surface takes place more quickly, as well as cooling of the atmosphere, when the nights are calm and starry, and consequently the deposits are always more abundant during those times.

Clouds.

AMOUNT OF CLOUD.—In estimation of the amount, I express a cloudless sky by a dash, and then reckon from 1 to 10—this last number indicating a perfectly cloudy sky; the intermediate numbers showing variation in degrees. Look midway between the visible horizon and the zenith, and then slowly turn round, and the relative amount of cloud can be easily judged from the distance between the clear and cloudy sky.

Varieties of.

There are endless modifications in the forms of clouds, and for those of my readers to whom the subject might be interesting, I might here give the classification of Howard,* which is now universally adopted. These variations are seen in perfec-

* Climate of London, vol. i. Introduction, p. xli. &c.

tion in every part of intertropical Western Africa, especially just before and after the rainy seasons.

Howard gives three simple and distinct forms and four intermediate or compound forms or modifications.

Principal Forms.

1. *Cirrus* consists of filaments, either parallel, flexuous, or diverging, which, by association, form a slender network or woolly hair expansion. They possess the least density, and are very high in the atmosphere, higher than all the other clouds, being more than ten miles. It is regarded as prognostic of wind, and is vulgarly called "*mares' tails.*"

2. *Cumulus.*—Hemispherical or conical heaps, increasing from an horizontal base resembling a mountain; its structure is exceedingly dense, and may be considered as the "cloud of day," and moves with the current next the earth. Some have compared the cumuli with bales of cotton.

3. *Stratus.*—A widely-extended, continuous, horizontal sheet, increasing from below upwards, forming often at sunset, and is the lowest of the clouds, having its inferior edge resting on the earth or water. It has a mean degree of density, persistent during night, and disappearing at sunrise.

Intermediate and Compound Modifications.

1. *Cirro-cumulus.* — Small, roundish, well-defined masses, in close horizontal arrangement or contact, most frequent during the warm and dry weather. The sky in this condition is said to be fleecy.

2. *Cirro-stratus.*—Horizontal or slightly inclined strata or masses, attenuated towards a part or the whole of their circumference, more compact than the cirri, bent downwards or undulated, apparently composed of a number of thin clouds at the zenith, at the horizon, or a long narrow band. This cloud is almost always followed by a lowering of temperature by wind and rain. This modification exhibits frequently the phenomena

known as the *solar* and *lunar halo,* of *parhelia, mock-suns, paraselenæ,* and *mock-moons.*

3. *Cumulo-stratus.*—The cirro-stratus blended with the cumulus, and either appearing intermixed with the heaps of the latter or superadding a wide-spread structure to its base. The distinct cumulo-stratus indicates the approach of thunder-storms; the indistinct is principally observed in the intervals of showers, rain, snow, or hail.

4. *Cumulo-cirro-stratus vel Nimbus.*—The rain-cloud. It is a horizontal sheet above which the cirrus spreads, while the cumulus enters it laterally and from beneath. It forms a system of clouds from which rain is falling.

Definition. Clouds are masses of visible vapour, or visible collections of minute globules of water in suspension in the atmosphere, placed at considerable distance above the earth's surface; the ordinary height is sometimes less than a mile, and, according to Professor Leslie, they can never rise beyond two miles above the line of perpetual congelation. Their formation is the result of admixture in the higher regions of the atmospheric strata of air of different degrees of saturation and temperature.

Ozonometer. OZONOMETER.—The observations were made from papers covered with a composition of iodide of potassium and starch, and exposed to the air.

Mode of preparation. This ozone paper is easily made by saturating strips of bibulous paper in a mixture made "by boiling one drachm of *white* starch in an ounce of distilled water for three minutes, in which are to be dissolved, when cold, twelve grains of chemically pure iodide of potassium."

When the paper is exposed to the atmosphere it is turned brown, and when immersed in water, yellow—the degree of intensity of discoloration indicates the amount of ozone. The principle of action is that the ozone oxidises the iodide of potassium, and so disengages the iodine free, which attacks and combines with the starch, forming a coloured compound—the iodide of starch. The estimation is expressed in numbers,

one being the smallest quantity, and 10 the highest degree of intensity.

There are both physical and chemical objections in the estimation of ozone, from the following circumstances :*— Objections in its estimation.

1. Other substances, such as nitric acid formed during electric storms, act on iodide of potassium as ozone; air containing ·00005 of its volume of this acid-coloured starch and iodide paper.

2. The reaction is effected by light, wind, humidity, and temperature, by expelling the free iodine.

3. Two chemical objections have been made: "Supposing that iodine is set free by ozone, a portion of it is at once changed by additional ozone into iodozone." This substance in ordinary temperature is very volatile, and, in contact with water, is changed into free iodine and iodic acid.

Some portion of the iodine, originally set free, being either volatilised or oxidised, never acts on the starch. Another error might be occasioned by the ozone itself acting on the starch.

The observations were made alone in countries along the sea coast, where it is supposed to be always abundantly produced; as it is found in large quantities on mountains and elevated localities; over lands covered with luxurious vegetation; over water, and on the sea coast.

WEATHER.—Generally speaking, the term weather includes the condition of the atmosphere which relates to the temperature—humidity, winds, pressure, &c.; but in the following observations I have confined it to the number of wet and dry days. Definition of.

Barometer.—The barometer was first invented by Evangelista Torricelli, and is so termed from βαρας, weight, and μετρον, measure. It is a very important instrument in meteorological observations, but unfortunately my register has been very limited, from an accident which destroyed my instrument. Barometer.

* Parke's *Practical Hygiene.* Beitrage zur Ozonometrie, von Dr V. Maach.

Rules for observation

We subjoin the following from Dr Pickford's Hygiene, as the rules laid down by Dr Halley, John Patrick, M. Cotte, and others, for our guidance in the use of the barometer as a weather-glass. We are, at the same time, to remember that the changes in the weather indicated by the barometer may occur in the upper part only, not extending to or being observable at the earth's surface; that sometimes variations produced by changes in the atmosphere of an adjoining district, and not from changes of wind or weather in the district of observation in the weight of the atmosphere over any given district, may arise:—

1. Indications of approaching changes of weather, and especially of the direction and force of winds, depend less on the absolute height of the mercury in the tube than on its falling and rising.

2. A height of 30 inches at the level of the sea is more indicative of settled weather and steady winds than any other height.

3. The barometer is said to be falling when the mercury in the tube is sinking, at which time its upper surface is almost always concave or hollow; the barometer is said to be rising when the mercurial column is lengthening, and its upper surface is convex or rounded.

4. The rising of the mercury presages, in general, fair, and its falling, foul weather, as rain, snow, high winds, and storms.

5. Below 30 inches the probability of rain is in an increased proportion with equal decrements of the mercurial column; above 30 inches the probabilities of fine weather are in a diminishing proportion with equal increments.

6. In calm weather, when the air is inclined to rain, the mercury is commonly low.

7. It sinks lowest in very great winds, though these be unattended with rain.

8. In very hot weather the falling of the mercury forebodes thunder.

9. In winter the rising presages frost; and in frosty weather, if the mercury, which is generally high, fall three or four tenths

of an inch, a thaw will certainly follow; but in a continued frost, if the mercury rise, it will certainly snow.

10. A rapid rise of the barometer indicates the approach of unsettled weather; a slow rise, the reverse.

11. A considerable and rapid fall is a sign of stormy weather, though of short duration, and is usually accompanied with rain.

12. A sudden rise in the barometer during a storm indicates that the worst is over.

13. The greatest depressions of the barometer are accompanied by rain and gales from the south and south-west; the greatest elevations by the north-west, north, and north-east winds.

14. Although the barometer almost always falls with the southerly and rises with a northerly wind, the reverse sometimes occurs, in which case the southerly wind will be dry, and the weather fine, whilst the northerly wind will be wet and violent.

15. When the barometer sinks considerably, high winds, rain, or snow will follow; the wind will be from the northward if the thermometer is low for the season, from the southward if the thermometer is high.

16. If, when the wind is from any point between north-west and north-east, the barometer fall and the thermometer rise, the wind will shift to the south.

17. If, when the wind is from any point between east and south-west, the barometer fall, an increasing gale from that quarter will ensue, which will be of shorter or longer duration according as the fall is rapid or slow.

18. Sudden falls of the barometer, with the wind from west, are frequently followed by violent storms from north-west or north, during which the mercury will rise to its former height.

19. If a gale set in from the east or south-east, and the wind veer by the south, the barometer will continue falling until the wind becomes south-west, when a comparative lull may occur, after which the gale will be renewed, and the veering of the

wind towards the north-west will be indicated by a rise of the barometer and a fall of the thermometer. These gales, which are accompanied by unusually high tides and the heaviest seas, are supposed to have a rotatory movement. When a lull in the course of the storm occurs, it is a sign that the centre of the revolving gale is passing over or near the place of observation.

20. If, after a storm of wind, the mercury remains stationary, fine weather, with the winds from the same quarter, will continue until the barometer begins to rise or fall, when a change may be looked for.

Pluviameter.—This instrument, commonly known as the rain-gauge, determines the amount of rain. The only observations on this point were made at Sierra Leone and the Gambia. The rain-gauge consisted of a round tin box with a groove at the top. The top is round, having a funnel inside, and fits on to this groove, which, when filled with water, forms a water valve. The opening above is circular, and descends, funnel-shaped, the small ends turning up to prevent evaporation. The lower part of the box is sunk in the ground, or in a receptacle in a pillar nearly to the groove. The upper part is put in, and a glass vessel placed below the funnel to receive the water; the glass is removed at 6 A.M. and at 6 P.M., the water taken out and measured in a glass vessel graduated to an inch and hundredths of an inch. One inch fall of rain signifies that on every square inch of surface a height of rain has fallen equal to one inch.

I shall, in the first place, consider the various conditions of physical climate, which takes into account its heat and cold, degree of salubrity, its humidity and draught; then the seasons of Western Africa; and afterwards, the influence of the climate on diseases,—or medical climate.

It must be confessed that philosphers have contended a great deal as to the real extent to which climate is to be viewed; some regard it as "any space distant from the equator and poles; another, as nothing more than a well-arranged table of the wind, of the thermometric, barometric, and hygrometric

degrees ; a third, as having reference solely to elevation above the level of the earth's surface ; a fourth, as consisting only of the internal heat of the globe ; while a fifth, supposed to be better informed than the rest, an authority who 'seemed to have been in nature's cabinet council,' pronounces climate to be influenced only by latitude and local elevation, and allows it to be but slightly affected by any other causes."

Malte Brun has given the following divisions, which I intend here to adopt as the causes of physical climate :—

1. The action of the sun upon the atmosphere.
2. The interior temperature of the globe.
3. Elevation of the earth above the level of the ocean.
4. The general inclination of the surface and its exposure.
5. The position of its mountains relative to the cardinal points.
6. The neighbourhood of great seas and their relative situations.
7. Geological nature of the soil.
8. Degree of cultivation and of population at which a country has arrived.
9. The prevalent winds.

To these Sir Ranald Marten has added—

10. Position in respect to the equator.
11. Position in respect to large rivers or lakes.
12. Position in respect to forest.

For meteorological purposes I shall divide the West African climate into four seasons, viz., the Rainy, Harvest, Harmattan, and Summer. The rainy season commences in May and terminates in September. On the Gold Coast and Bights we meet with two successions of rains, respectively known as the former and latter rains. The first terminates about the beginning of July, and the second commences in August, and continues sometimes to the middle of October. In Sierra Leone and the Gambia and Senegal, the rain commencing in the latter part of Four seasons.

May continues to the middle of September; it commences later and terminates earlier.

Rainy Season.—Near the equator, from the Gaboon to Cape Lopez, the seasons are divided into two, viz., the dry and the rainy season; the latter occupies the longest portion of the year.

The rainy season commences about the middle or end of September, and terminates in the beginning or end of May; thus occupying the whole of what is the dry season in the Senegambia region.

About the middle or end of December the rains cease for a short time, varying from a month to six weeks, and then recommence in the latter end of January or beginning of February. This period is called "*the little dry season,*" and is the period when the sun is nearest the southern tropics. As the sun again approaches the line, the rains recommence, and are at their height when the sun is on the line. Here, that is in the regions between the Gaboon and Cape Lopez, the hottest period of the year is in the rainy season, the hot months being December, January, February, and March.

Before the little dry season the rains are heavy, but they are still more so after it, and severe tornadoes and thunder storms blow and roar during February, March, and April.

Dry Season.—The dry season commences in May or beginning of June and terminates in September. The weather is now very cold; the thermometer in the morning is sometimes registered at 64° Fahr. At its commencement, the morning and nights are cold, and the wind veers from south-west to south. The sky is overcast; "the wind," writes Dr Chaillu, "on the coast, which had blown from the land in the morning and from the sea by night, now almost turns into one steady sea breeze, which blows strongly, especially in the afternoon and evening." This season is not interrupted by any short rainy season. During this season there is very little dew.

The harvest occupies September, October, and a part of November; it is earlier on the Gold Coast and Bights than

any other part. The harmattan, a part of November, December, and January, and a part of February. Summer, a part of February, March, April, and a part of May.

In a medical point of view, we might divide the West African tropical year into three divisions—

1. The diarrhœal or dysenteric division.
2. The febrigenous or malarious division.
3. The congestive or pulmonic division.

The first comprises the months of February, March, April, a part of May, October, and part of November.

The second, the months of May, June, latter part of August and September.

The third, the latter part of November, December, January, viz., the harmattan months, a part of June, July, and a part of August.

In these divisions of the year I have attempted to particularise the disease most prevalent in each. During heavy rains, and in the harmattan, fever is seldom heard of, and when it does occur its attack is generally mild, unless accelerated by a previous bad habit or undue exposure to malarious districts. The harmattan cold dry wind places a veto to the manifestation of malarious fever on the system; it patches up all the malarious beds, but dries up large lakes or ponds sufficiently to allow them to generate malaria or to form muddy swamp. Fever of a congestive nature might occasionally be produced by its driving the blood from the surface to the interior organs. During the rains the different malarious beds are so much inundated that they are incapable of generating malaria except when there is little rain, or in those countries where the fall of rain is scanty, as on the Gold Coast and a part of the Bight of Biafra, where remittent fever of a most dangerous type sometimes occurs. In this section congestive diseases are of frequent occurrence; the natives suffer principally from affection of the lungs.

In the febrigenous section there are seldom cases of pul-

monary affection except those of long standing; there are sometimes sporadic cases of diarrhœa and dysentery, but fever is the most prevalent disease.

In the diarrhœal or dysenteric section the constant heat of the sun, and the effect of putrescent vegetable matter mingling with the drinking water, as well as water impregnated with animal life and fæcal matter, lead to the most fatal forms of diarrhœa and dysentery. At Sierra Leone dysentery is an occasional disease and seldom proves fatal; but sometimes comes on epidemically, when it is very fatal; whilst on the Gold Coast, the Bights of Benin and Biafra, and the Gambia, dysentery and diarrhœa are frequent in occurrence and dangerous in type.

I must here, however, premise that in considering the climate and meteorology of a coast-line of more than 3000 miles, many variations in the season and meteoric phenomena will be observed as we proceed from one place to the other, but I shall endeavour to make that due correction and allowance which will be found necessary in treating the various phenomena.

CHAPTER II.

THE ACTION OF THE SUN UPON THE ATMOSPHERE—TEMPERATURE OF THE AIR.

THE changes in the temperature of Western Africa must be regarded in two broad lights, viz., *periodical* and *non-periodical;* in the former we have to consider the position of the different places with respect to the sun; the difference between the temperature of the coldest and the hottest months, giving the amplitudes of the daily or yearly fluctuations. The *non-periodic changes* are caused by shifting winds, clouds, rains, radiation, and evaporation. Changes—Periodic. Non-periodic.

In Western Africa the temperature of the air is at its lowest at 4 o'clock A.M., and at its maximum at 3 P.M., from which it gradually begins to fall until 4 A.M.; and since the heat of climate does not depend only on the immediate effects of the rays of the sun, but on their continuous operation, this forms the daily periodic changes in the temperature of the air. These changes are less in the sea coast towns than in the interior, and greater in elevated positions than on the sea level. Thus they are greater in Leicester Mountain at Sierra Leone than in Freetown; greater in the Cameroon Mountains than at Lagos; and in the Aquapim Mountains than at James' Town, Accra. Daily periodic changes.

The coldest month in Western Africa, as a whole, is in January; this is particularly to be noticed in places where the harmattan wind is regular, such as Sierra Leone, the Gambia and Senegal; but on the Gold Coast and the Bights of Biafra Yearly periodic changes.

and Benin, the harmattan seldom lasts more than a few days, and consequently we cannot regard January as the coldest month: from actual observation, I might safely say that September is the coldest month in those regions.

In Senegal and the Gambia the hottest month is April, the hottest days being from the 23d of April to the 2d May. In Sierra Leone and Liberia the hottest days are between the 20th February and the 1st March, and on the Gold Coast and Bights in the middle of February. The coldest day in Senegal, the Gambia, and Sierra Leone, is between the 1st and 6th of January. On the Gold Coast and Bights the coldest day is in the beginning of September.

Position of sun's rays.

Of the British possessions, Gambia, in its geographical position, is situated in 13° 40′ north of the equator, Sierra Leone or Freetown in 8° 29′ N., Cape Coast in 5° 6′ N., Lagos in 6° 24′ N., Cape Lopez 36′ 10″ S., the utmost southern limit of Western Africa. It is a known rule, that the nearer a place is situated to the equator the hotter it must be, although certain local non-periodic causes can modify it. At all these places of the British possessions which I have named, the rays of the sun at noon fall vertically or perpendicularly for two months of the year, or at an angle which deviates from a right angle by $3\frac{1}{2}$° at the utmost reckoning; the general rule being, that all places situated at $23\frac{1}{2}$° on either side of the equator receive the sun's rays vertically at one period of the year.

Class of climate.

The climate of the Gambia, Senegal, and the Casamanza, when compared with other parts of the coast, must be regarded as extreme and excessive, the amplitude of the yearly fluctuations and undulations being greater than at any other part. In 1865 the thermometer fell in the beginning of January on land to 64° F., on the 22nd December it was 63°, while in April of the same year it went up to 111°—an observation which no other part of the coast will present. The climate of these other parts may be regarded as limited, being in a great measure equable, presenting only limited yearly variations.

The temperature of the air depends—

1. On the inclination of solar rays to the surface of the earth.

2. On the distribution of land and water.

3. The condition of the country whence proceed the prevailing winds.

4. The neighbourhood of sea, rivers, and lakes.

5. The elevation of the land.

M. Cotte has laid down the following axioms for our guidance in the consideration of temperature :—

1. The extreme degrees of heat are almost everywhere the same ; this, however, is not the case in regard to the extreme degrees of cold.

2. The thermometer rises to its extreme height oftener in the temperate zones than in the torrid zone.

3. It changes very little between the tropics ; its variations, like those of the barometer, are greater the more one proceeds from the equator towards the poles.

4. It rises higher in the plains than on the mountains.

5. It does not fall so much in the neighbourhood of the sea as in inland parts.

6. The wind has no influence on its motions.

7. Moisture has a peculiar influence on it, if followed by the wind which disperses it.

8. The greatest heat and greatest cold take place about six weeks after the northern or southern solstice.

9. The thermometer changes more in summer than in winter.

10. The coldest period of the day is before sunrise.

11. The greatest heat in the sun and in the shade seldom takes place on the same day.

12. The heat decreases with far more rapidity from September to October, than from July to September (*i.e.* in temperate climates).

13. It is not true that a very cold winter is the prognostic of a very hot summer (nor a very cold harmattan, or excessive rain-fall, the prognosis of a hot summer, *Author*).

Effect of heat in shade.

The effect of great heat in shade, is in the first place to produce a most depressing effect on the nervous system, interfering with the action of the stomach; and from the rarefaction of the air with respiration. There is greater waste of tissue from the direct effect of heat, and the urine is always loaded with lithates.

Dr Parkes has given the following as the effect of high atmospheric temperature in shade on Europeans, residing or passing into the tropics :—

1. The temperature of the body does not rise greatly—not more than ·5 or 1° F. (John Davy); from 1° to 2½° and 3° (Eydaux and Brown Sequard). The temperature of the body is the result of the opposing action of two factors—1st, of development of heat from the chemical changes of the food, and by the conversion of mechanical force into heat, or by direct absorption from without; and, 2nd, and opposed to this, of evaporation from the surface of the body, which regulates internal heat. So beautifully is this balance preserved, that the stability of the animal temperature in all countries has always been a subject of marvel. If anything, however, prevents this evaporation, radiation and the cooling effect of moving wind cannot cool the body sufficiently in the tropics. Then, no doubt, the temperature of the body rises, and the extreme discomfort always attending abnormal heat of body commences. In experiments in ovens, Blagden and Fordyce bore a temperature of 260°, with a small rise of temperature (2½° F.), but the air was dry, and the heat of the bodies was reduced by perspiration. When the air in ovens is very moist and evaporation is hindered, the temperature of the body rises rapidly.*

2. The respirations are lessened in number (Ludwig) in animals subject to heat, and the same is believed to hold good in the tropics. If so, less carbonic acid, and, presumably, less water, are eliminated. (When the weather is extremely hot,

* Even 7° to 8° F. Ludwig "Lehrb. der Phys." Second edition, b. ii. p. 730.

and hot winds are blowing, the author has observed the respiration to be often stifled, and considerably below the standard; the author has known it to be as low as 15 in a minute).

3. The heart's action is somewhat increased in frequency, perhaps not in force, in new comers, in tropical climates.

4. The digestive powers are somewhat lessened; there is less appetite, less desire for animal food, and more wish for cool fruit (and cooling drinks in abundance, *Author*). The quantity of bile secreted by the liver is not increased, if the stools are to be taken as a guide (Marshall in 1819, John Davy, Morehead, Parkes), though Lawson believed that an excess of colouring matter passes out with the stools; nothing is known of the condition of the usual liver work.

5. The skin acts much more than usual, and great local hyperæmia and swelling of the papillæ occur in new comers, giving rise to the familiar eruption known as "*prickly heat.*" In process of time, if exposed to great heat, the skin suffers apparently in its structure, becoming of a slight yellow colour, from, probably, pigmentary deposits in the deep layers of the cuticle.

6. The urine is lessened in quantity (and this is caused by the excessive activity of the sudorific glands, *Author*). The urea is lessened, as shown by experiments in hot seasons at home, and during voyages (Dr Forbes Watson and Dr Becher.)* It is not yet certain whether this is simply from lessened food. The pigment has been supposed to be increased (Lawson, the *Author*), but this is doubtful. The chloride of sodium is lessened, the amount of uric and phosphoric acid is uncertain (the uric acid is increased, *Author*).

7. The effect on the nervous system is generally considered as depressing and exhausting, *i.e.*, there is less vigour of mind and body. But it is undoubted that the greatest exertions, both of mind and body, have been made by Europeans in hot climates. Robert Johnson thought as much work could be

* Proceedings of the Royal Society, 1862.

got out of men in hot as in temperate climates. It is probable that the depressing effects of heat are most felt when it is combined with great humidity of the atmosphere, so that evaporation from the skin, and consequent lessening of bodily heat, is partly or totally arrested.

To which may be added—

8. Excessive secretion of the sudorific glands, with an increase of the solids of the sweat, especially the chlorides.

Different thermal scales.

I must now give the thermometrical observations which have been made; and to those who have not been acquainted with the different scales used in science, I may here state that there are four in daily use, but for my observations I have employed that used in England:—

Fahrenheit's Scale, the freezing point of which is registered at 32°, and the boiling point at 212°.

Centigrade Scale is that used in France, and amongst most of the Continental nations; the freezing point is placed at zero (0°), and the boiling point at 100°. This is the most convenient scale.

Reaumur's Scale is that used in Russia; the freezing point is at zero, and the boiling point at 80°.

De Lisle's Scale is very little used; the boiling point is placed at zero, whilst the freezing point at 150°.

Mode of finding corresponding points.

To find the corresponding point of each of the four scales, we have to consider 1 degree of Fahrenheit to be equal to $\frac{5}{9}$ths of a degree of Centigrade, to $\frac{4}{9}$ths of a degree of Reaumur, and to $\frac{5}{6}$ths of a degree of De Lisle, and by arithmetic calculation the quotient will be very easily found.

The *maximum*, *medium*, and *minimum* of the three daily registers are noticed, and I may here remark that the medium gives the continuous medium observation during the whole month, and not the difference between the maximum and minimum.

Gold Coast, Anamahae.

January 1860.

Thermometric Register.

Maximum Observations.—*Morning*—1st and 12th, 80°; 2nd, 11th, and 13th, 79°. *Noon*—2nd, 10th, and 12th, 80°; 11th, 82°. *Evening*—3rd and 12th, 80°. Thermometrical observations, 1860.

Medium Observations.—*Morning*—4th and 10th, 77°. *Noon*—4th, 81°. *Evening*—4th and 7th, 77°.

Minimum Observations.—*Morning*—7th, 73°. *Noon*—5th, 79°. *Evening*—6th, 76°.

Remarks.—Thundered severely on the afternoon of the 2nd, direction S.W. by S.; slightly on the 1st. It was cloudy on the 1st towards E. and N.E; on the 11th during the day and night; only in the day on the 20th, and in the night on the 22nd and 29th. It rained on the 16th and 30th. There was a halo around the moon on the 3rd, extending about 2° to 3°. On the 4th, 5th, and 6th the harmattan wind blew very severely at 11 p.m., when the thermometer was placed outside, it fell 10° in a few minutes; there was a heavy haze all over the horizon on the 5th and 6th. The thermometer in the sun during the blowing of the harmattan wind was 89°. The wind was S.W. and S.W. by S. mostly in the afternoon. On the 4th, 5th, and 6th was N.E. and E.N.E.; during a severe blow of the harmattan the barometer rose considerably. General remarks.

M'Carthy's Island, River Gambia.

January 1865.

Thermometric Register.

Maximum Observations.—*Morning*—24th and 25th, 74°; 28th and 30th, 73°. *Noon*—23rd, 95°; 24th, 26th, 27th, and 29th, 94°. *Evening*—23rd, 24th, 26th, 27th, and 28th, 98°; 25th and 29th, 96°. Observations, 1865.

Medium Observations.—*Morning*—6th, 9th, and 10th, 69°; 4th, 68°. *Noon*—3rd, 9th, 20th, and 31st, 88°; 6th, 87°. *Evening*—1st, 9th, 16th, and 19th, 91°; 3rd and 8th, 90°.

Minimum Observations.—*Morning*—2nd, 64°. *Noon*—14th, 81°. *Evening*—14th, 82°.

Remarks.—Most of the mornings cold and foggy; E. and N.E.

winds were the prevailing winds—sometimes hot and sultry. Cloudy on the 12th, 13th, 14th, 18th, 19th, 20th, and 22nd. It thundered, with lightning, on the 12th from 4 to 7 P.M.; on the 14th at 5 P.M. Rest of the month the weather was fine.

1866.

January 1866.

The average thermometric observation in the morning was 71°·06, at noon was 82°·709, in the afternoon or evening was 86°·838; the mean of the month was 78°·94.

MAXIMUM OBSERVATIONS.—*Morning*—23rd and 30th, 77°. *Noon*—31st, 91°; 29th, 90°. *Evening*—31st, 95°; 29th, 93°.

MEDIUM OBSERVATIONS.—*Morning*—2nd, 10th, 11th, 12th, 21st, 24th, and 28th, 72°; 5th, 16th, 22nd, 25th, and 26th, 71°. *Noon*—2nd, 7th, and 16th, 83°; 3rd, 15th, 17th, and 23rd, 82°. *Evening*—2nd and 7th, 86°; 18th, 85°.

MINIMUM OBSERVATIONS.—*Morning*, 8th, 64°. *Noon*—14th, 73°. *Evening*—14th, 78°.

Remarks.—The prevailing wind was N.E.; there was a strong sea breeze on the 7th and 8th. It was cloudy in the mornings from the 9th to the 16th; on the 21st, 22nd, 23rd, and 30th; and on evening of the 24th. It was fine the rest of the time.

THERMOMETRICAL OBSERVATIONS FOR JANUARY 1863, 1864, 1865, AND 1866, TAKEN AT M'CARTHY'S ISLAND, RIVER GAMBIA.

DAYS.	1863.			1864.			1865.			1866.		
	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.
1	70	83	85	72	85	...	67	89	91	73	84	87
2	72	82	86	72	86	87	64	89	92	72	83	86
3	73	80	84	69	85	88	65	88	90	70	82	89
4	68	80	83	68	87	88	68	89	94	69	86	92
5	72	83	88	72	87	88	73	92	95	71	85	88
6	78	80	84	72	88	88	69	87	92	70	88	89
7	72	84	86	70	86	89	69	84	89	67	83	86
8	75	85	87	70	86	89	70	85	90	64	77	83
9	68	84	85	68	85	89	69	88	91	70	80	83
10	70	84	86	71	84	87	69	85	88	72	80	82
11	70	88	89	70	80	86	70	85	88	72	77	80
12	77	90	93	68	80	86	73	86	89	72	80	82
13	73	85	87	65	83	86	73	83	84	74	80	82
14	72	88	90	67	83	87	73	81	82	70	73	78
15	74	89	90	70	89	...	71	84	86	69	82	88
16	76	88	91	...	86	...	71	89	91	71	83	88
17	74	89	91	75	87	...	72	89	92	70	82	88
18	76	90	91	...	...	89	73	91	92	69	80	85

THERMOMETRICAL OBSERVATIONS FOR JANUARY 1863-1866—*continued.*

DAYS.	1863.			1864.			1865.			1866.		
	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.
19	74	90	91	74	90	92	72	91	91	69	76	80
20	76	90	92	65	90	92	73	88	93	66	80	84
21	77	91	92	76	89	...	71	91	94	72	81	84
22	78	89	90	72	88	...	71	92	94	71	84	87
23	79	91	93	...	89	...	72	95	98	77	82	90
24	80	88	90	74	86	...	74	94	98	72	86	89
25	78	89	91	72	89	...	74	92	96	71	85	90
26	76	88	90	72	90	95	72	94	98	71	85	90
27	74	87	89	69	90	...	72	94	98	72	87	92
28	76	88	90	71	93	93	73	92	98	72	87	91
29	80	88	90	73	91	92	67	94	96	74	90	93
30	76	88	90	70	91	93	73	91	95	77	88	90
31	78	87	90	71	85	88	67	88	92	74	91	95

At Sierra Leone, in 1820, the *maximum* observation was 80°; *medium*, 80°; *minimum*, 79°.

SLAVE COAST, BIGHT OF BENIN—QUITTAH STATION.

February 1860.

MAXIMUM OBSERVATIONS.—*Morning*—3rd, 6th, 7th, 14th, 22nd, 23rd, and 29th, 84°; 1st, 7th, and 8th, 83°. *Noon*—17th, 90°; 7th, 9th, and 27th, 89°; 24th and 28th, 88°. *Evening*—16th, 23rd, and 26th, 86°; 4th, 85°·25.

MEDIUM OBSERVATIONS.—*Morning*—15th, 80°. *Noon*—2nd and 25th, 87°. *Evening*—1st and 28th, 85°.

MINIMUM OBSERVATIONS.—*Morning*—16th, 78°. *Noon*—12th, 84°. *Evening*—9th, 79°.

Remarks.—Thundered on the 10th; direction W.S.W. and N.W.; on the 17th slightly N.E.; and on the 26th, E.N.E. It was very hot and sultry on the 4th, 7th, 17th, 19th, 24th, and 27th. Cloudy during the day on the 3rd, 8th, 9th, 18th, 22nd, and 23rd; and during the evening, that is, from 7 P.M. to bed time, or to 10 P.M., on the 7th, 10th, 14th, 16th, 17th, 19th, and 26th. Slight harmattan was felt on the morning of the 5th, there was in consequence a haze round the visible horizon. Severe lightning towards N.W. by N. on the evening of the 4th, 14th, 17th, and 18th; W. and S.W. on the nights of the 12th and 20th; E. during the day on the 22nd, 23rd, and 29th. Sea breeze blowing generally S.W. by W.; commences on the 1st, 2nd, 3rd, and 26th, at 9 A.M.; on the 6th, 8th,

9th, 10th, 13th, 16th, and 20th, at 10 A.M.; on the 5th, 7th, 17th, 18th, and 19th, at 1 noon; on the 4th, 13th, 14th, 21st, 23rd, and 24th, at 2 P.M.; on the 22nd, 27th, 28th, and 29th, at 3 P.M.

N.B.—In these observations I have not reckoned the fractions of an hour.

M'Carthy's Island, River Gambia.

February 1865.

Maximum Observations.—*Morning*—18th, 83°; 19th, 80°. *Noon*—17th, 98°; 18th, 97°; 9th and 20th, 96°. *Evening*—17th, 102°; 18th and 20th, 100°.

Medium Observations.—*Morning*—12th, 14th, and 15th, 75°; 13th, 24th, and 27th, 74°. *Noon*—3rd, 15th, 21st, and 22nd, 92°; 4th and 28th, 91°. *Evening*—11th and 22nd, 96°; 5th and 10th, 95°.

Minimum Observations.—*Morning*—2nd, 65°. *Noon*—26th, 86°. *Evening*—24th and 27th, 89°.

Remarks.—The prevailing wind was N.E. Very sultry at noon and afternoon during the whole of the month. Very foggy and cloudy on the 24th, 25th, 26th, 27th, and 28th.

February 1866.

Maximum Observations.—*Morning*—2nd, 77°; 17th and 22nd, 76°; 1st, 6th, 11th, 15th, 21st, and 28th, 75°. *Noon*—15th, 91°; 2nd, 4th, 13th, 14th, 16th, 21st, and 26th, 89°. *Evening*—15th, 97°; 13th and 22nd, 96°.

Medium Observations.—*Morning*—7th, 10th, and 26th, 74°; 3rd, 5th, 9th, 18th, 19th, 23rd, and 28th, 73°. *Noon*—6th, 12th, and 19th, 86°; 23rd, 24th, and 25th, 85°. *Evening*—12th and 27th, 93°.

Minimum Observations.—*Morning*—14th, 70°. *Noon*—20th, 83°. *Evening*—6th, 89°.

Remarks.—The whole of the month was fine; from the 1st to the 12th N.E. and E. wind blew all day. In the rest of the month, during a part of the day towards the afternoon, S.W. sea breeze blew. It was cloudy on the 28th. The average thermometrical observations in the morning was 73°·464; noon, 87°·571; evening, 92°·642. The mean of the month was 83°·05.

THERMOMETRICAL OBSERVATIONS FOR FEBRUARY 1863, 1864, 1865, AND 1866. RIVER GAMBIA.

DAYS.	1863.			1864.			1865.			1866.		
	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	6 P.M.
1	76	88	90	76	92	93	67	89	93	75	88	92
2	78	87	89	73	...	...	65	88	93	77	89	92
3	74	85	88	74	89	...	69	92	93	73	88	90
4	71	84	86	75	90	95	67	91	93	71	89	92
5	76	87	90	74	91	...	67	93	95	73	88	91
6	78	86	87	75	79	73	76	95	98	75	86	89
7	76	86	87	68	67	68	77	93	97	74	88	92
8	78	88	90	67	75	...	79	93	97	71	88	91
9	76	89	90	73	80	...	78	96	97	73	88	91
10	78	90	94	69	80	...	71	91	95	74	88	91
11	76	91	95	70	82	87	71	93	96	75	87	92
12	78	93	98	72	90	91	75	89	91	72	86	93
13	75	94	97	73	89	...	74	89	92	72	89	96
14	78	94	97	77	91	93	75	87	92	70	89	95
15	80	89	96	75	91	95	75	92	94	75	91	97
16	83	89	98	74	87	92	78	95	98	72	89	95
17	80	92	95	76	93	93	79	98	102	76	88	95
18	74	89	94	73	93	95	83	97	100	73	88	94
19	78	88	9	74	...	92	80	95	99	73	86	92
20	...	...	...	72	...	...	76	96	100	71	83	92
21	...	...	...	69	88	89	79	92	97	75	89	95
22	...	...	...	69	89	89	76	92	96	76	88	96
23	...	...	...	69	...	...	73	88	94	73	85	92
24	...	...	...	79	...	93	74	89	89	72	85	90
25	...	...	...	78	...	98	76	89	91	73	85	91
26	...	...	...	80	93	97	73	86	90	74	89	94
27	...	...	...	74	92	92	74	87	89	74	88	93
28	...	...	...	70	89	93	76	91	94	75	87	91
29	...	...	...	76	94	98	...	...	...	...	...	...

At Sierra Leone, in 1820, the *maximum* thermometric observation was 87°; the *medium*, 80°; the *minimum*, 80°. There was very little sea breeze; month was hot and sultry. Two tornadoes in the course of the month.

SLAVE COAST, BIGHT OF BENIN.

March 1860.

MAXIMUM OBSERVATIONS.—*Morning*—19th, 80°; 8th, 10th, 18th, 20th, 21st, and 26th, 84°. *Noon*—19th, 20th, and 27th, 89°; 10th and 16th, 88°. *Evening*—10th, 12th, 19th, 27th, and 30th, 86°; 3rd, 7th, 22nd, and 31st, 85°.

Medium Observations.—*Morning*—22nd, 27th, and 29th, 83°. *Noon*—2nd, 8th, 12th, 13th, 14th, 16th, 25th 26th, and 30th, 87°. *Evening*—8th, 14th, 15th, 16th, 22nd, and 31st, 84°.

Minimum Observations.—*Morning*—23rd, 8°. *Noon*—14th and 21st, 84°. *Evening*—31st, 81°.

Remarks.—Thundered in the afternoon of the 7th; on the evening of the 11th, direction E. and N.N.W.; 16th, noon, N.E. by N. and N.; 19th, afternoon, W.N.W; 22nd, afternoon, N.; 23rd, in various directions; 30th, morning, E.N.E., S.E.; 31st, afternoon, various directions. Lightning on the 5th, evening, N.W. by N.; 7th, N. and N.E., E.; 11th, evening, E.N.E.; 13th, N.; 16th, evening, N. and E.N.E.; 28th, evening, E.N.E. Tornado, 13th (with rain), 20th, and 31st. Rained on the 6th at 7 p.m.; 11th and 13th, in the evening; 20th, during the night; 31st, afternoon, when it was dark all over the horizon from W.; evening, S. to E. The occurrence of sea breeze varied greatly, sometimes at 10 a.m., sometimes at 1, 2, or 3 o'clock. Very sultry on the 14th, 18th, 21st, and 25th.

River Gambia.

March 1865.

Maximum Observations.—*Morning*—2nd, 83°; 5th and 20th, 81°. *Noon*—23rd, 100°; 24th, 99°. *Evening*—23rd, 104°; 22nd and 24th, 103°.

Medium Observations.—*Morning*—4th, 8th, 10th, 21st, 22nd, 24th, and 28th, 78°; 1st, 11th, 17th, and 19th, 77°. *Noon*—5th, 7th, and 9th, 95°; 3rd, 4th, 13th, 16th, and 29th, 94°. *Evening*—4th and 15th, 97°; 1st and 20th, 96°.

Minimum Observations.—*Morning*—15th, 72°. *Noon*—27th, 90°. *Evening*—3d, 93°.

Remarks.—It was dark and cloudy on the 1st, 2nd, 3rd, 26th, 27th, and 28th. Strong N.E. hot wind blew nearly all the month at noon. Foggy on the river in the morning of the 20th. The average temperature in the morning was 77°·8; at noon it was 95°·32; in the evening it was 99°. The mean temperature of the month was 88°.4.

March 1866.

Maximum Observations.—*Morning*—21st, 84°; 24th and 27th, 83°. *Noon*—19th, 24th, and 31st, 96°; 20th, 28th, and 30th, 95°. *Evening*—24th, 102°; 25th and 31st, 100°.

Medium Observations.—*Morning*—8th, 9th, 17th, and 28th, 77°; 11th, 76°. *Noon*—8th, 10th, and 17th, 90°; 11th, 89°. *Evening*—3rd, 9th, 10th, and 17th, 96°; 8th, 95°.

MINIMUM OBSERVATIONS.—*Morning*—15th, 70°. *Noon*—14th, 78°. *Evening*—14th, 86°.

Remarks.—Cloudy on the morning of the 1st. In most of the mornings and afternoons, N., N.E., and E. wind blew. On the evening of the 10th it blew from S.W. by S.; on afternoon of 12th, from S.W.; on the 13th, S.W. by S.; at night, N.; on the morning of 18th, E.S.E.—evening, strong S.W.; afternoon of 19th, N.W. by N. On the 20th there was a beautiful network of picturesque clouds; on the 28th, morning was sultry, the afternoon hazy.

THERMOMETRICAL OBSERVATIONS FOR MARCH 1863, 1864, 1865, 1866.
RIVER GAMBIA.

DAYS.	1863.			1864.			1865.			1866.		
	7 AM.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 P.M.	Noon.	4 A.M.
1				73	90	95	77	92	96	78	88	94
2				77	98	...	83	93	95	80	87	94
3				76	...	97	80	94	93	79	91	96
4				76	96	98	78	94	97	81	93	98
5				76	97	...	81	95	98	78	94	100
6				74	93	98	75	96	99	78	93	97
7				70	...	99	76	95	99½	75	...	97
8				...	91	97	78	97	98	77	90	95
9				74	96	...	79	95	100	77	91	96
10				76	90	99	78	93	99	...	90	96
11	No observation taken.			77	90	...	77	98	101	76	89	93·30
12				...	...	99	79	97	101	72	86	93
13				77	93	98	76	94	100½	78	85	90
14				77	...	...	74	93	98	71	78	86
15				74	92	...	72	91	97	70	82	87
16				73	94	99·5	73	94	99	73	...	93
17				75	93	...	77	98	102	77	90	96
18				78	93	95	76	98	102	78	94	98
19				73	92	97·5	77	98	101½	80	96	99·30
20				73	93	96	81	96	102	80	95	98
21				72	93	96	78	98	102	84	94	97
22				72	93	...	78	98	103	79	92	97
23				72	...	95	79	100	104	80	92	99
24	80	94	98	74	96	98	78	99	103	83	96	102
25	78	90	104	78	99	100·5	80	97	101½	82	93·30	100
26	76	90	94	79	96	98	75	93	94	80	93	99
27	79	88	95	78	97	100·5	80	90	95	83	94	98
28	78	92	94	81	100	100·5	78	93	96	77	95	99
29	80	92	94	...	99	100	80	94	95	79	93	98
30	86	90	94	75	96	98	79	96	98	79	95	...
31	85	91	92	76	94	97	80	96	99	...	96	100

At Sierra Leone the maximum thermometer in March was 86°; medium, 80°; minimum, 79°. There was no regular sea breeze; the

prevailing wind was from N.N.W. The month was generally hot and sultry.

Slave Coast, Bight of Benin.

April 1860.

Maximum Observations.—*Morning*—13th and 15th, 84°; 2nd, 6th, 14th, and 21st, 83°. *Noon*—13th, 89°; 11th, 88°. *Evening*—1st, 5th, 16th, 19th, 20th, 25th, 26th, and 29th, 87°.

Medium Observations.—*Morning*—1st, 3rd, and 12th, 82°. *Noon*—14th, 87°·45. *Evening*—15th, 16th, 19th, 25th, and 29th, 84°.

Minimum Observations.—*Morning*—28th, 79°. *Noon*—4th, 83°. *Evening*—4th, 7th, 9th, 10th, 22nd, 20th, and 30th, 83°.

Remarks.—Thundered in the night. Wind on the 1st, S.W by W.; 3rd, noon, W.S.W.; 6th, evening, E.N.E.; 18th, night, S.W. by W., W., N.W., evening S.W; 23rd, at 6 A.M., S.E.; 25th, day, N.N.E. Lightning, very vivid flashes on 1st, N.W. by N. in evening; 2nd, night, N.; 3rd, night, S.E. and W.S.W.; 6th, S.E. by S. ¾ S. at first, but afterwards became general; 9th, day, N.W.; 11th, day, N., N.W., and W.; 13th, day, N.; 18th, forked, night, N.E., N., S.W., and S.; 25th, N.N.E. Tornado on 1st, at night; 16th, day; 18th, very severe, night; 21st, afternoon. Rained on the 1st, night; 2nd and 3rd, in the night; and on the 6th, in the day, very severe, and lasted for four hours; 18th, rain lasted one hour and a half; 21st, afternoon, two hours; 25th, commenced at 11, and terminated at 1.30; 27th, very heavy, day. There was great uniformity in the temperature during the day on the 4th, it being 83° from 10 A.M. to 6 P.M.; the evening was very bright and clear on the 5th and 6th. The day dull, cool, and pleasant on the 7th, 14th, and 20th; hot and sultry on 8th. Wind on the 11th, morning, S.W.; noon and evening, S.W. by S.; 13th, morning, S.—afternoon and evening, W.S.W.; 14th and 16th, S.; 24th, E. and N.E. Beautiful sunsets commenced on the 25th. During the tornado of the 21st, the ozone in the atmosphere increased 4°·30. Very foggy on the morning and evening of the 29th and 30th.

River Gambia.

April 1864.

Maximum Observations.—*Morning*—16th, 85°. *Noon*—21st, 25th, and 26th, 101°. *Evening*—26th, 104°; 15th, 25th, 27th, and 28th, 103°.

Medium Observations.—*Morning*—5th, 6th, 22nd, 24th, and 28th, 80°. *Noon*—19th and 30th, 96°. *Evening*—22nd, 97°.

Minimum Observations.—*Morning*—1st, 9th, 11th, and 23rd, 75°. *Noon*—12th, 91°. *Evening*—11th and 23d, 95°.

Remarks.—Rained on 12th at 7.30 a.m. On the 2nd, at 9 p.m., the thermometer was 89°; 4th, at 10 p.m., 89°; 8th, at 10 p.m., 81°; 15th, at 6 p.m., 100°; 25th, at 10 p.m., 95°; 26th, at 7 p.m., 99°. It was cloudy on the 19th.

M'Carthy's Island.

April 1865.

Maximum Observations.—*Morning*—12th and 28th, 86°; 29th and 30th, 85°. *Noon*—27th, 103°; 28th and 30th, 102°. *Evening*—30th, 110°; 27th and 28th, 108°.

Medium Observations.—*Morning*—1st, 4th, 14th, 16th, 17th, and 23rd, 82°; 3rd, 9th, 10th, and 24th, 81°. *Noon*—5th, 15th, 17th, and 18th, 95°; 16th, 20th, 23rd, 24th, and 25th, 97°. *Evening*—21st, 106°; 4th, 6th, 15th, 17th, 18th, 22nd, 24th, and 26th, 103°.

Minimum Observations.—*Morning*—19th, 76°. *Noon*—19th, 93°. *Evening*—13th and 19th, 93°.

Remarks.—Strong winds very prevalent; no register kept of the direction. Very cloudy on the 10th, 11th, 12th, and 13th. The average temperature in the morning, 81°·6; noon, 98°; evening, 102°·56. The mean temperature of the month was 92°·08.

Thermometrical Observations for 1863, 1864, 1865.

River Gambia.

Days.	1863.			1864.			1865.		
	7 a.m.	Noon.	4 p.m.	7 a.m.	Noon.	4 p.m.	7 a.m.	Noon.	4 p.m.
1	79	94	92	75	...	99	82	99	102
2	75	92	90	76	100	99	79	99	102
3	72	82	86	81	99	101·5	81	100	102
4	70	81	85	81	...	...	82	100	103
5	71	79	85	80	100	...	83	98	102
6	70	86	91	80	...	99	79	100	103
7	78	91	95	79	98	100	78	99	102
8	81	91	92	...	95	99	79	95	100
9	82	97	98	75	97	...	81	95	100
10	81	96	97	76	99	98	81	94	100
11	83	94	98	75	...	95	86	100	102
12	81	90	96	76	91	...	83	95	99

THERMOMETRICAL OBSERVATIONS FOR 1863–1865—*continued.*

DAYS.	1863.			1864.			1865.		
	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	7 P.M.
13	80	91	96	78	...	...	83	93	98
14	79	96	97	79	...	102·5	82	96	102
15	79	90	98	83	100	103	83	98	103
16	79	96	99	85	99	102	82	97	100
17	80	91	98	82	95	99·5	82	98	103
18	80	94	98	78	...	99	83	98	103
19	80	96	100	83	96	100	76	93	94
20	83	94	98	81	100	102	78	97	102
21	86	93	99	82	101	102·5	83	101	106
22	86	100	101	80	95	97	84	99	103
23	84	98	98	75	94	95	82	97	102
24	82	98	98	80	97	100	81	97	103
25	82	95	98	83	101·5	103	80	97	102
26	82	98	98	83	101	104	79	99	103
27	82	94	96	83	100	103·5	80	103	108
28	82	92	96	80	100	103·5	86	102	108
29	81	96	99	82	97	102·5	85	100	107
30	81	93	102	77	96	100·5	85	102	109

At Freetown, Sierra Leone, in 1820, the *maximum* thermometer was 84°; the *medium*, 81°; and *minimum*, 79°. The wind was from S.W. to N.W.; the weather generally fine.

In 1860, in the first week ending Friday the 5th, the *maximum* observation was 84°; *medium*, 79·8°; *minimum*, 77°. The weather was wet on the third and fourth weeks.

QUITTAH, THE BIGHTS.

May 1860.

MAXIMUM OBSERVATIONS.—*Morning*—6th, 81°·10; 4th, 5th, and 22nd, 81°. *Noon*—1st, 86°; 8th, 11th, 12th, 18th, 19th, and 22nd, 85°. *Evening*—18th, 86°; 12th, 83°·40.

MEDIUM OBSERVATIONS.—*Morning*—22nd, 78°·40. *Noon*—10th, 83°·50. *Evening*—6th, 82°·10.

MINIMUM OBSERVATIONS.—*Morning*—25th and 31st, 75°. *Noon*—14th and 26th, 80°. *Evening*—24th, 78°.

Remarks.—Severe thunder-storms on the 9th at 3 P.M.; direction, N., N.E. by N., and S.W., zenith; murmurings of thunder on N.E. Tornado in the evening with no thunder, but lightning in E.N.E., and S.S.W., on the 1st. Rained on the 1st in the evening and night; 3rd, at night; 4th, slight drizzle in the morning; 9th, very heavy, and lasted for three-quarters of an hour; 13th, heavy, with

high winds at night; 20th, evening; 21st, slight drops; 23rd, heavy in day and night; 24th, slight drizzle in morning; 27th, slight drizzle. Wind, 6th, morning, due E.—afternoon, S.S.E.; 7th, S.S.E. all day; 8th, morning, W.—afternoon and evening, S.; 9th, morning, W.—afternoon, S.E. by S.; 11th, very strong, S.W.; 16th, S.W. all day; 18th, W.S.W.; 27th, N.W.; 29th, W.S.W.; 30th, S.S.W.; 31st, N.N.E., morning—S.S.W. rest of the day. Beautiful sunset on the 15th of a light red tint; very beautiful on the 26th, consisting of bright light red, deep red, light and deep blue, intense yellow, and light and deep slate colour. Rainbow observed morning of the 5th; direction, S.W. by W. ½ W. to N.N.W. Ozone; there was no ozone in the atmosphere on the 11th and 13th. No cloud on the 8th, 12th, 15th, and 26th, morning; 12th, 14th, 17th, and 26th, noon; 8th, 13th, 16th, 19th, and 23rd, evening.

River Gambia.

May 1864.

Maximum Observations.—*Morning*—3rd, 86°; 12th, 84°. *Noon*—11th, 103°; 10th, 101°. *Evening*—10th, 104°·5; 1st, 3rd, and 11th, 104°.

Medium Observations.—*Morning*—6th, 16th, 17th, and 22nd, 78°. *Noon*—9th, 19th, and 26th, 77°; 20th, 97°; 19th and 26th, 96°. *Evening*—9th, 100°·5; 14th, 20th, and 27th, 100°.

Minimum Observations.—*Morning*—25th, 70°. *Noon*—28th, 90°. *Evening*—8th, 96°.

Remarks.—Weather was cloudy. State and direction of the winds not registered. Rained slightly on the 29th at 7 a.m. and 12 p.m. The average temperature in the morning, 79°·35; noon, 95°·75; evening, 100°·65. The mean temperature of the month was 90°.

May 1865.

Maximum Observations.—*Morning*—7th, 88°; 1st, 87°. *Noon*—1st, 101°; 2nd, 3rd, 8th, 15th, 17th, 19th, 20th, and 28th, 99°. *Evening*—8th, 108°; 2nd and 15th, 107°.

Medium Observations.—*Morning*—10th, 13th, 17th, 18th, 23rd, 26th, 28th, 29th, and 30th, 84°. *Noon*—14th, 18th, 23rd, 25th, 27th, and 30th, 97°. *Evening*—12th, 17th, 27th, 28th, and 31st, 103°.

Minimum Observations.—*Morning*—12th and 24th, 80°. *Noon*—11th and 21st, 93°. *Evening*—6th, 99°.

Remarks.—The weather was cloudy almost every day, accompanied with a thick haze; on some days the hot wind blew. The highest

thermometrical register observed at 9 P.M. was 97°, on the 15th; the lowest 83°, at 9 P.M. on the 21st. A few drops of rain fell on the night of the 27th. The average thermometrical register in the morning was 83°·66; in the afternoon, 96°·93; and in the evening, 103°·51. The mean thermometer in the month was 93°·58.

THERMOMETRICAL OBSERVATIONS FOR THE GAMBIA AND GOLD COAST.

DAYS.	River Gambia.									Gold Coast Command.		
	1863.			1864.			1865.			1860.		
	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.
1	78	89	98	76	99	104	87	101	104	78	86	83
2	77	89	98	81	95	101	83	99	107	76	83	82
3	80	91	101	86	100	104	86	99	105	80	83	82
4	81	93	98	83	95	103	82	98	104	81	82	81
5	84	89	95	81	91	101	85	95	100	81	82	80
6	81	89·30	98	78	...	101·5	81	95	99	81·10	83	82·10
7	80	90	100	80	94	98	88	98	100	79	84	82
8	81	98	101	75	91	96	85	99	108	80	85	83
9	84	99	101	77	99	100·5	83	96	104	80	83	80
10	85	98	100	79	101	104·5	84	95	104	78	83·50	80
11	84	95	100	82	103	104	81	93	102	80	85	83
12	80	94	101	84	99	101	80	96	103	80	85	83·50
13	81	91	97	81	95	...	84	96	104	78	84	81
14	80	90	95	83	93	100	82	97	106	77	80	80
15	74	89·	94	79	98	103	85	99	107	76	83	82
16	78	90	91	78	98	101	83	97	104	78	83	83
17	78	91	98	78	94	102	84	99	103	77	80	80
18	78	90	97	76	94	102	84	97	105	79	85	84
19	75	90	96	77	96	102·5	86	99	106	80	85	83
20	78	88	97	80	97	100	83	99	105	76	80	82
21	80	97	100	82	95	102	...	93	102	80	84	83
22	84	95	99	78	94	101	81	...	102	81	85	83
23	80	97	98	79	94	98	84	97	104	79	83	83
24	82	98	99	71	92	97	80	95	101	76·45	82	78
25	81	92	98	70	98	99	83	97	105	75	82	80
26	78	88	98	77	96	...	84	96	100	79	84	81
27	80	91	95	82	95	100	85	97	103	78·40	83	80
28	79	80	97	80	90	96	86	99	103	75	83	82
29	80	92	100	83	...	96	84	95	102	80	84	80
30	82	91	99	81	98	101	84	97	104	78	83	81
31	78	85	90	83	93	99	83	95	103	75	82	80

In 1820, at Sierra Leone, the *maximum* register was 85°; the *medium*, 81°; and the *minimum*, 79°. The wind was principally from S.E. to N.W. The weather was generally close and sultry; and there were four tornadoes during the month.

The *maximum* register in the week ending Friday, May 10th, 1860, was 84°, the *medium* 77°·6, *minimum* 72°; in the week end-

ing 17th the *maximum* was 82°, *medium* 76°·6, *minimum* 70°; in the week ending Friday, May 24th, the *maximum* was 85°, *medium* 77°, *minimum* 67°; in the last week ending May the 31st the *maximum* was 84°, *medium* 78°, *minimum* 70°.

The *maximum* observation at Sierra Leone, in May 1860, was 85°; on the Gold Coast, in the same month and year, it was 86°; but in the River Gambia, in the same month in 1865, it was 108°—thus making the River Gambia at an average of 20° hotter than these two places.

The wind was principally from S.W., but blows often from N.W., N., and N.E. There were several rainy days throughout the month.

Gold Coast.

June 1860.

Maximum Observations.—*Morning*—3rd, 80°; 17th, 21st, and 28th, 79°. *Noon*—2nd, 84°; 1st, 16th, and 17th, 83°. *Evening*—1st and 2nd, 81°; 24th, 80°·20.

Medium Observations.—*Morning*—18th, 20th, 22nd, 23rd, and 27th, 77°. *Noon*—24th, 82°·45. *Evening*—10th, 18th, and 27th, 79°.

Minimum Observations.—*Morning*—19th and 30th, 74°. *Noon*—28th, 76°·30. *Evening*—28th, 76°·20.

Remarks.—On the 15th a rainbow was observed in the evening running S.S.E. ½ E., and lost in the zenith about 40°. On the 27th there was a slight roar of thunder at 6 in the evening. Rain during the day on the 3rd, 16th, 21st, and 28th; during the night on the 11th, 15th, 18th, and 20th; drizzled on the 19th and 20th. Thundered on the 3rd—direction N.E. by E., S.W. by W., and W.—accompanied with lightning. Wind, 1st, S.W.; and 2nd—morning, N.W. by W.—rest of the day, S.S.W.; 3rd, morning, W.N.W.—evening, S.W.; 19th, N.W.; 20th, morning, N.W.—evening, S.W. by W.; 23rd and 24th, evening, W.S.W. On the 26th the wind blew a gale. There was very heavy dew on the night of the 14th, and heavy fog in the morning. No cloud on the 29th in the day, and none in the evening of the 23rd, 25th, and 26th.

River Gambia.

June 1865.

Maximum Observations.—*Morning*—2nd, 5th, 18th, and 25th, 85°. *Noon*—2nd, 97°; 1st and 2nd, 96°. *Evening*—1st, 106°; 2nd, 105°.

Medium Observations.—*Morning*—22nd and 30th, 80°. *Noon*—13th, 15th, 27th, 29th, 91°. *Evening*—23rd, 24th, and 25th, 97°.

MINIMUM OBSERVATIONS.—*Morning*—30th, 80°. *Noon*—28th, 84°. *Evening*—26th, 87°.

Remarks.—It was cloudy in the morning of the 1st, 2nd, 4th, 5th, 6th, 9th to 13th, 15th to 22nd, 24th to 30th. Heavy rain, with tornado, at 11 P.M., on the 5th, 9th, and 27th; at 8 P.M. on the 12th and 28th; at 3 A.M. on the 22nd and 26th; and at 9 P.M. on the 29th. At 2 A.M. of the 13th there was dry tornado. It rained heavily, without tornado, on the 14th, from 4 A.M. till 10 A.M.; and on the 23rd from 2 to 4 P.M. On the 8th it blew a gale from S.E. from 3 to 6 A.M. The wind was constantly from S.W. and W. At 9 P.M. on the 7th the thermometer was 94°·9. The average thermometrical register of the month was 81°·83 in the morning, 92°·1 at noon, 98°·43 in the afternoon. The mean temperature of the month was 90°·13.

THERMOMETRICAL OBSERVATIONS FOR 1863, 1864, 1865.

RIVER GAMBIA.

DAYS.	1863.			1864.			1865.		
	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.
1	81	87	94	81	98	101·5	82	96	106
2	80	91	97	84	99	103·5	85	97	105
3	80	90	94	85	96	101	82	96	102
4	80	91	96	81	97	100	83	95	103
5	81	88	94	86	91	102	85	95	101
6	84	91	95	83	96	99	82	91	98
7	82	90	94	80	91	93	82	95	104
8	82	91	98	83	91	98	81	90	99
9	83	88	93	83	94	99	83	95	104
10	82	92	94	83	95	97	81	89	95
11	79	86	90	84	...	98	81	93	99
12	80	88	92	86	93	98	83	93	102
13	81	86	91	...	96	97	81	91	99
14	79	88	93	78	...	98	78	85	90
15	83	94	96	84	...	98	82	91	99
16	84	98	101	80	...	91	83	92	98
17	81	91	94	82	93	98	83	95	101
18	81	85	92	82	92	98·5	85	95	102
19	79	88	92	83	92	96	85	94	99
20	79	84	96	83	85	89	83	94	101
21	80	86	92	81	93	94	83	94	102
22	84	86	90	82	91	...	80	89	95
23	80	84	88	80	93	95	83	93	97
24	80	84	88	83	80	82	79	93	97
25	80	84	88	77	88	93	85	93	97
26	81	86	89	78	91	93	77	86	87
27	79	82	87	76	89	90	81	91	93
28	78	80	86	79	88	89	76	84	90
29	76	79	83	78	90	...	81	91	95
30	80	83	88	82	92·5	98·5	80	87	93

At Sierra Leone, in June 1820, the *maximum* register was 80°; *medium*, 79°; *minimum*, 78°. The weather was rainy and cloudy. In the first week ending 7th June 1860, the *maximum* register was 84°; *medium*, 77°·5; *minimum*, 67°. In the second week (14th) *maximum*, 83°; *medium*, 76°·9; *minimum*, 70°. In the third week, *maximum*, 82°; *medium*, 76°·5; *minimum*, 71°. In the fourth week (28th), *maximum*, 82°; *medium*, 76°·1; *minimum*, 68°. The weather was generally wet, and the wind from every point of the compass.

Slave Coast.

July 1860.

Maximum Observations.—*Morning*—9th, 79°; 25th, 26th, and 28th, 78°. *Noon*—4th and 8th, 80°; 6th, 9th, 10th, and 11th, 82°. *Evening*—6th, 8th, and 19th, 80°.

Medium Observations.—*Morning*—3rd, 76°·25; 8th, 14th, 16th, 18th, 20th, 21st, 24th, 27th, and 30th, 76°. *Noon*—7th, 80°·30. *Evening*—15th, 17th, 21st, 25th, and 29th, 78°.

Minimum Observations.—*Morning*—1st and 10th, 74°. *Noon*—17th, 22nd, 29th, 30th, and 31st, 78°. *Evening*—30th and 31st, 76°.

Remarks.—Thundered at noon on the 2nd, wind N.N.W.; 5th, N.W. by N. Lightning, 2nd, W.N.W. ¾ W.; 8th, N.N.W.; 14th, N.; 20th, forked and sheet (repeated) night, N. Rained, 4th, morning; 5th, at day; 16th, in the night; 17th, day and night; 20th, night; 21st, 22nd, 30th, and 31st, in the day; 24th and 26th, at night. Wind very high on 3rd and 5th, S.; 6th, S.W.; 9th, S.W. by W.; 10th, W.S.W.; 11th, W.; 12th, S.W. by S. and S.W. Beautiful sunset, roseate network on deep blue background. There was no cloud on the morning of the 2nd, and on the afternoon of the 2nd, 10th, 11th, and 20th.

River Gambia.

July 1864.

Maximum Observations.—*Morning*—1st and 22nd, 84°. *Noon*—11th, 93°. *Evening*—5th, 6th, 16th, 21st, and 31st, 94°.

Medium Observations.—*Morning*—5th and 9th, 80°. *Noon*—24th and 31st, 89°. *Evening*—22nd, 90°; 19th, 89°.

Minimum Observations.—*Morning*—17th and 19th, 76°. *Noon*—3rd, 85°. *Evening*—2nd, 85°.

Remarks.—Rained on the 3rd, 4th, 6th, 7th, 8th, 14th, 15th, 16th, 17th, 18th, 19th, 22nd, 23rd; heavy, 24th; heavy, 25th and

29th. Strong tornado on the 4th. Thundered on the 12th. Cloudy on the 2nd and 12th.

July 1865.

MAXIMUM OBSERVATIONS.—*Morning*—3rd, 85°. *Noon*—4th, 93°; 2nd and 3rd, 92°. *Evening*—3rd, 98°; 2nd, 97°.

MEDIUM OBSERVATIONS.—*Morning*—21st, 26th, and 29th, 80°. *Noon*—1st, 22nd, 23rd, 26th, 28th, and 29th, 87°. *Evening*—7th, 13th, 17th, 20th, and 23rd, 90°.

MINIMUM OBSERVATIONS.—*Morning*—15th and 19th, 75°. *Noon*—19th and 30th, 81°. *Evening*—30th, 81°.

Remarks.—Tornado on the 5th, 5 A.M.; 6th, 7 P.M.; 15th, 2 A.M.; 17th, 6 P.M.; 19th, 2 A.M. Rained on the 5th, 6th, 7th, night; 15th, 17th, 19th, 20th, 7 P.M.; 21st, morning and evening; 25th, 6 P.M.; 26th, 7 P.M.; 27th, 5 P.M.; 28th and 29th, day; very heavy at night, 30th; very heavy, 31st. Fine on the 2nd and 9th, but cloudy rest of time. The average thermometric register in the month was 80°·64; at noon, 87°·52; in the evening, 9°·6. The mean temperature of the month was 85°·35.

THERMOMETRICAL OBSERVATIONS FOR 1863, 1864, 1865.
RIVER GAMBIA.

DAYS.	1863.			1864.			1865.		
	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.
1	78	84	86	84	92	91	81	87	91
2	81	88	91	...	86	85	83	92	97
3	80	86	89	79·5	85	87	85	92	98
4	81	84	86	79	...	...	82	93	93
5	79	82	84	80	90	94	81	90	...
6	81	85	89	83	91	94	84	91	93
7	78	84	85	83	92	88	81	86	90
8	78	83	86	83	86	87	81	89	91
9	80	84	87	80	91	...	81	89	93
10	81	85	88	82	...	93·5	83	90	93
11	82	85	88	83	93	92	82	88	92
12	83	86	90	81	92	86	83	89	93
13	79	86	88	...	91	92	82	88	90
14	82	86	89	81·5	91	84	83	90	93
15	82	86	88	...	...	92	75	85	91
16	82	80	79	79	91	94	82	89	91
17	82	86	88	76	...	88	83	89	90
18	82	86	88	82	92	...	81	89	92
19	82	86	82	76	88	89	75	81	85
20	82	86	82	83	90	...	79	86	90
21	82	85	89	83	92·5	94	80	85	88

THERMOMETRICAL OBSERVATIONS FOR 1863–1865—*continued.*

DAYS.	1863.			1864.			1865.		
	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	7 P.M.
22	81	84	86	84	90	90	81	87	88
23	80	86	88	81	90	87	81	87	90
24	80	84	82	79	89	84	81	86	87
25	79	86	84	79	91	91	79	86	89
26	78	82	88	82	92	92	80	87	89
27	78	80	80	83	90	92	79	84	87
28	78	84	88	81	91	92	79	87	87
29	80	86	88	77	86	88	80	87	85
30	80	84	87	82	91	...	76	81	81
31	80	85	88	82	89	94	77	84	85

At Sierra Leone, the *maximum* observation in 1820 was 84°; the *medium*, 80°; and *minimum*, 78°.

The weather was unusually fine,—rather hot and sultry. The wind was from S.W. to N.W. The rains were heavy, but not very frequent.

ACCRA, GOLD COAST.

August 1860.

MAXIMUM OBSERVATIONS.—*Morning*—3rd, 4th, and 5th, 76°; 12th, 75°. *Noon*—1st and 2nd, 83°. *Evening*—4th, 78°; 1st, 77°.

MEDIUM OBSERVATIONS.—*Morning*—10th, 20th, and 29th, 74°·40. *Noon*—4th, 15th, and 19th, 79°. *Evening*—3rd, 7th, 19th, 25th, and 26th, 75°.

MINIMUM OBSERVATIONS.—*Morning*—30th and 31st, 73°. *Noon*—29th, 74°. *Evening*—29th and 31st, 73°.

Remarks.—The observations of this month were rather incomplete, from unavoidable circumstances. It was foggy on the night of the 3rd. Very cloudy during the whole of the month. It rained for fifteen days, including the night, sometimes very heavy. Very misty in the evening and night of the 30th.

RIVER GAMBIA.

August 1864.

MAXIMUM OBSERVATIONS.—*Morning*—8th and 20th, 83°; 4th, 82°. *Noon*—2nd, 91°; 3rd, 21st, and 31st, 90°. *Evening*—2nd, 92°; 3rd, 22nd, and 31st, 91°.

MEDIUM OBSERVATIONS.—*Morning*—3rd, 7th, 9th, 10th, 14th, 18th, 19th, 22nd, 23rd, and 31st, 79°. *Noon*—6th, 15th, and 18th, 87°. *Evening*—7th, 87°; 30th, 86°.

MINIMUM OBSERVATIONS.—*Morning*—28th, 75°. *Noon*—14th, 83°. *Evening*—10th and 20th, 78°.

Remarks.—Tornado on the 1st, 10th, 17th (3 A.M.), and 31st. Fine on the 2nd, 3rd, 18th, 19th, 26th, 29th, 30th, and 31st; rained heavily the rest of the month. The wind was principally from S.W. to N.; on the 30th and 31st was N.E.

August 1865.

MAXIMUM OBSERVATIONS.—*Morning*—23rd, 83°; 16th, 82°. *Noon*—23rd, 90°; 15th, 89°. *Evening*—15th, 92°; 14th and 16th, 91°.

MEDIUM OBSERVATIONS.—*Morning*—2nd, 9th, 17th, and 28th, 80°; 4th, 5th, 6th, 8th, 11th, 12th, 13th, 21st, 24th, 25th, 26th, and 29th, 79°. *Noon*—27th, 84°. *Evening*—7th, 85°; 18th and 27th, 84°.

MINIMUM OBSERVATIONS.—*Morning*—31st, 76°. *Noon*—10th, 78°. *Evening*—30th, 79°.

Remarks.—Rained on the 4th, 5th, 6th, 7th, 8th, 10th, 11th, 12th, 16th, 17th, 18th, 19th, 20th, 23rd, 24th, 25th, 26th, 27th, and 30th. Tornado on the 30th, at 11 A.M. Thundered on the 11th. Cloudy on 1st, 2nd, 3rd, 9th, 13th, 14th, 15th, 21st, 22nd, 28th, and 29th. The average morning thermal register was 79°·45; afternoon, 85°·54; evening, 87°·6. The monthly mean was 83°·258.

THERMOMETRICAL OBSERVATIONS FOR 1862, 1863, 1864, 1865.
RIVER GAMBIA.

DAYS.	1862.			1863.			1864.			1865.		
	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.
1	No observation from 1st to 4th.			79	83	86	78	...	84	77	85	87
2				82	85	87	80	91	92	80	86	89
3				82	81	86	79	90	91	81	87	90
4				79	83	88	82	...	82	79	86	88
5	86	86	82	79	79	80	...	89	88	79	86	87
6	81	85½	79·30	77	83	82	80	87	...	79	87	88
7	77	79	77	79	82	86	79	85	87	77	85	85
8	82	83	81	80	83	86	83	...	...	79	85	87
9	81·30	86	84	79	83	85	79	...	85	80	87	90
10	81·30	87	88	77	84	86	79	85	78	81	78	81
11	82	86	89	78	81	80	78	89	83	79	85	90
12	81	89	91	79	83	80	80	89	89	79	86	87

Thermometrical Observations for 1862–1865—*continued.*

Days.	1862.			1863.			1864.			1865.		
	7 a.m.	Noon.	4 p.m.	7 a.m.	Noon.	4 p.m.	7 a.m.	Noon.	4 p.m.	7 a.m.	Noon.	4 p.m.
13	81	90	90·30	79	84	86	80	88	83	79	85	90
14	86	89	95	78	83	87	79	83	...	81	87	91
15	82	87	83	79	84	88	78	87	81	81	89	92
16	83	87	84	77	83	85	78	86	87	82	88	91
17	82	88	87	76	83	85	76	86	79	80	85	89
18	80	87·30	90	78	82	84	79	87	88	81	87	84
19	79	88	89	76	80	82	79	89	89	77	86	89
20	80	87.30	89	77	81	83	83	89	78	77	79	83
21	80·30	88	86	76	78	80	80	90	85	79	88	90
22	80	88	90	76	82	86	79	...	89	81	87	90
23	80	86	90	78	81	84	79	...	91	83	90	86
24	77	88	90	78	83	86	76	84	80	79	85	81
25	79	82·30	82·30	78	82	86	80	86	83	79	85	83
26	77	87	88	79	84	85	80	86	85	79	85	81
27	80	89	90	78	84	87	77	...	88	79	84	84
28	80	91	92	77	84	85	75	85	88	80	87	89
29	78	84	86	78	84	87	80	...	88	79	87	89
30	81	86	82·30	76	82	85	77	86	86	81	80	79
31	78	83	88	77	81	83	79	90	91	76	85	89

In August 1820, at Freetown, Sierra Leone, the *maximum* thermometer was 82°; *medium*, 80°; *minimum*, 75°. There were very heavy rains during the month; some days were sultry and hot.

Sierra Leone.

August 1860.

Maximum and Minimum Thermometers.

Highest Maximum Observations.—At 9 a.m.—On 1st, 2nd, 3rd, 4th, 5th, and 9th, 78°. At 9 p.m.—On 17th, 83°; on 3rd, 4th, 15th, and 25th, 82°.

Lowest Maximum Observations.—At 9 a.m.—On 18th, 74°. At 9 p.m.—On 7th, 10th, 23rd, and 31st, 76°·5.

Highest Minimum Observations.—At 9 a.m.—On the 17th, 76°; 16th, 75°. At 9 p.m.—On the 16th, 77°; 13th, 21st, and 22nd, 76°.

Lowest Minimum Observations.—At 9 a.m.—On the 18th and 24th, 71°. At 9 p.m.—31st, 71°·5.

Dry and Wet Bulb Thermometers.

Maximum Dry Bulb Observations.—At 9 a.m.—4th, 17th, and 25th, 79°; 9th, 78°. At 9 p.m.—3rd, 4th, 15th, and 16th, 77°; 2nd and 24th, 76°·5.

Minimum Dry Bulb Observations.—At 9 a.m.—18th, 73°. At 9 p.m.—31st, 71°·5.

Maximum Wet Bulb Observations.—At 9 a.m.—17th, 76°; 2nd, 3rd, and 19th, 75°. At 9 p.m.—2nd, 74°·5; 3rd, 74°.

Minimum Wet Bulb Observations.—At 9 a.m.—15th, 18th, 20th, and 28th, 71°. At 9 p.m.—17th, 28th, 29th, and 31st, 70°.

Thermometrical Observations for 1860. Sierra Leone.

Days.	Maximum and Minimum Thermometers.				Wet and Dry Bulb Thermometers.				Thermometer of Barometer.	
	Maximum.		Minimum.		Dry Bulb.		Wet Bulb.			
	9 A.M.	9 P.M.	9 A.M.	9 P.M.	9 A.M.	9 P.M.	9 A.M.	9 P.M.	9 A.M.	9 P.M.
1	78	80	73	75	75	76·5	73	73	77	77
2	78	81	73	75	77	76·5	75	73	77	76
3	78	82	73	74	77·5	77	75	74	78	78
4	78	82	73	75	79	77	73	72·5	78	77
5	78	80	73	75	76	76	73	72	77	77
6	76	79·5	72·5	73·5	77	75	74	71	77	77
7	75	76·5	72	73	74·5	74	72·5	72	76	76
8	75	77	72	75	75	76	73	72	76	75
9	78	81	72·5	75	78	76	73	73	77	77
10	76	76·5	74	74	74·5	74	73	72	76	76
11	77	78·5	72	74	77	74	73	72	77	76
12	77	81	73	75	76·5	75·5	74	73·5	77	77
13	77	80·5	74	74	76	75	74	72·5	77	77
14	77	79	73·5	75	75	75·5	72	70·5	77	77
15	76	82	73	76	76	77	71	71	77	78
16	77	80	75	77	76	77	73·5	73·5	77	78
17	79	83	76	73	79	74	76	70	79	78
18	74	79	71	72	75	75·5	71	74·5	76	77
19	77	79	72	74	76·5	74·5	75	72	78	77
20	77	80	73	75	77	76	71	71	77	77
21	77	79	72	76	77	76	73·5	72	77	77
22	77	79	74	76	76·5	76	74	73·5	77	78
23	77	76·5	73	73	76	74	74	71	77	77
24	74	80	71	73·5	74	75	72	70·5	76	77
25	79	82	71·5	75·5	79	76·5	73	70·5	78	78
26	77	78·5	74	75	76·5	76	72·5	72	77	77
27	76	77	72	74	74	75	72	71·5	76	77
28	74·5	78	72	73·5	75	74	71	70	76	76
29	77·5	80	72	74	77·5	74	72·5	70	77	77
30	75·5	81·5	72·5	75·5	75	75	71·5	71	76	77
31	76	76·5	72	71·5	74	71·5	71·5	70	77	77

CHRISTIANSBORG, GOLD COAST.

September 1860.

MAXIMUM OBSERVATIONS.—*Morning*—23rd, 28th, and 29th, 76°; 6th, 11th, 24th, 26th, and 27th, 75°. *Noon*—25th and 29th, 79°; 22nd, 23rd, 26th, and 28th, 78°. *Evening*—24th, 26th, and 29th, 76°.

MEDIUM OBSERVATIONS.—*Morning*—7th, 13th, 16th, and 18th, 74°. *Noon*—5th, 77°·30. *Evening*—12th, 73°.

MINIMUM OBSERVATIONS.—*Morning*—12th, 15th, and 17th, 72°. *Noon*—4th, 74°. *Evening*—12th, 72°.

Remarks.—Lightning on the 10th, N. and N.E.; 17th, W.N.W.; 18th, N.N.W.; 24th, W. to N.W.; 27th, N.E.; 28th, W.N.W. Thundered on the afternoon of the 23rd, N.N.E., and zenith. Wind, W. and S.W. most prevalent; on the 3rd, W. all day; 5th, W. in morning, S.W. by W. afterwards; 6th, morning, S.W. by W.; 7th, very still morning—afternoon, strong S.; 8th, N.W.; 9th, N.E. Drizzled at noon on 1st; in the morning of the 22nd and 27th. Morning and evening of the 15th and 20th very foggy; and evening of the 19th.

RIVER GAMBIA.

September 1864.

MAXIMUM OBSERVATIONS.—*Morning*—15th, 81°·5; 3rd, 5th, 7th, 9th, and 18th, 81°. *Noon*—5th, 92°; 15th, 91°. *Evening*—5th, 93°; 9th and 10th, 92°.

MEDIUM OBSERVATIONS.—*Morning*—2nd, 4th, 11th, 16th, 17th, and 30th, 78°. *Noon*—2nd, 19th, 21st, 25th, and 26th, 89°. *Evening*—17th, 23rd, and 26th, 89°.

MINIMUM OBSERVATIONS.—*Morning*—24th, 75°. *Noon*—12th and 29th, 85°. *Evening*—12th, 16th, and 30th, 86°.

Remarks.—Heavy tornado on the 5th, 11th, 15th, and 22nd. Rained, 8th, 12th, 17th, 21st, 24th, and 27th. The days were generally fine. The prevailing wind S.W.; on the 27th, N.E.

September 1865.

MAXIMUM OBSERVATIONS.—*Morning*—3rd, 4th, 21st, and 30th, 83°; 23rd and 29th, 82°. *Noon*—26th, 29th, and 30th, 90°; 3rd and 21st, 89°. *Evening*—30th, 94°; 3rd, 13th, 20th, 21st, 26th, and 29th, 92°.

Medium Observations.—*Morning*—2nd, 6th, 7th, 10th, 15th, 17th, and 24th, 80°. *Noon*—1st, 5th, 7th, 10th, 15th, 17th, 19th, and 28th, 87°. *Evening*—14th, 87°.

Minimum Observations.—*Morning*—8th, 14th, 18th, and 19th, 77°. *Noon*—4th, 83°. *Evening*—15th, 80°.

Remarks.—Rained on the 1st, 4th, 5th, 8th, 10th, 14th, 15th, 16th, 18th, 19th, 20th, and 23rd. Tornado on the 4th, at noon; 15th, at 1 p.m.; 30th, slight at night. Hazy on the 11th, morning; 26th, all day. The rest of the days were cloudy.

The average temperature in the morning was 79°·8; in the afternoon, 86°·66; at 4 p.m., 88°·63. The mean temperature of the month was 84°·216.

Thermometrical Observations for 1862, 1863, 1864, 1865.
River Gambia.

DAYS.	1862.			1863.			1864.			1865.		
	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.
1	77	86	82	77	83	89	79	89	90	81	87	89
2	78	87	82	78	86	90	78	88	89·5	80	88	91
3	78	86	88	80	87	82	81	89	91	83	89	92
4	80	85	89·30	79	90	84	78	...	89·5	83	83	82
5	78	85	90	78	87	87	81	92	93	79	87	91
6	80	80	86	79	76	82	79	...	88	80	86	88
7	78	85	89	80	88	88	81	89	91	80	87	90
8	80	88	90	78	85	89	80	...	87	77	82	85
9	80	89	84	79	88	87	81	90	92	81	88	84
10	79	84	86	78	90	89	83	90	92	80	87	88
11	78	86	88	79	86	91	78	87	87·5	78	85	85
12	80	88	90	75	84	87	77	85	86	78	86	90
13	78	85	84	80	78	87	80	89	90	79	88	92
14	78	86	88	80	88	90	80	89	90	77	85	87
15	84	87	89	79	88	90	81·5	91	...	80	87	80
16	78	85	88	81	89	92	78	...	86	77	84	85.
17	78	87	89	79	88	89	78	...	89	80	87	88
18	80	88	89	78	91	90	81	89	91	77	86	89
19	74	80	84	80	90	92	76	88	87	77	87	89
20	80	85	88	80	87	89	79	86	87	81	88	92
21	78	86	88	80	88	90	76	88	90	83	89	92
22	80	87	90	78	88	92	77	87	90	78	86	89
23	78	80	90	84	91	94	80	89	89	82	80	84
24	80	91	88	85	90	92	75	86	87	80	88	90
25	80	86	88	80	90	93	77	88	90	79	85	90
26	82	90	90	82	90	92	77	88	89	79	90	92
27	77	86	90	80	91	90	76	86	87	81	88	89
28	80	90	90	80	89	92	77	87	90	79	87	90
29	77	86	90	72	88	88	76	85	...	82	90	92
30	82	86	90	80	88	92	78	87	86	83	90	94

At Freetown, Sierra Leone, in 1820, the *maximum* thermometric observation for September was 83°; *medium*, 80°; *minimum*, 78°. The weather was close and sultry, and there were heavy rains at night.

Sierra Leone.

September 1860.

Maximum and Minimum Thermometers.

Highest Maximum Observations.—At 9 a.m.—18th, 82°·5; 23rd and 26th, 82°. At 9 p.m.—25th and 26th, 84°; 4th, 15th, and 18th, 83°.

Lowest Maximum Observations.—At 9 a.m.—10th, 74°. At 9 p.m.—10th, 74°.

Highest Minimum Observations.—At 9 a.m.—21st and 24th, 75°; 6th, 9th, 14th, and 27th, 74°. At 9 p.m.—14th, 77°·5; 17th, 18th, 23rd, and 26th, 77°.

Lowest Minimum Observations.—At 9 a.m.—15th and 30th, 69°. At 9 p.m.—28th and 29th, 70°.

Dry and Wet Bulb Thermometers.

Maximum Dry Bulb Observations.—At 9 a.m.—26th, 82°; 18th, 20th, and 25th, 81°. At 9 p.m.—14th, 18th, 20th, 22nd, 23rd, and 25th, 77°; 13th, 15th, 17th, 25th, 27th, and 30th, 76°.

Minimum Dry Bulb Observations.—At 9 a.m.—19th, 73°·5. At 9 p.m.—29th, 71°.

Maximum Wet Bulb Observations.—At 9 a.m.—26th, 77°; 14th, 20th, 25th, and 29th, 76°; 23rd and 28th, 75°. At 9 p.m.—21st, 75°; 13th and 14th, 74°.

Minimum Wet Bulb Observations.—At 9 a.m.—5th, 6th, and 10th, 71°·5. At 9 p.m.—29th, 68°.

Remarks.—Thundered on the 23rd, 24th, and 27th. Tornado on the 13th, at 4 a.m.; 25th, slightly, at 3 p.m., at which barometer fell from 29°·65 to 29°·5; 26th, 28th, at 7 p.m.; 29th, at 8 p.m.

THERMOMETRICAL OBSERVATIONS FOR 1860. SIERRA LEONE.

DAYS.	Maximum and Minimum Thermometers.				Wet and Dry Bulb Thermometers.				Thermometer of Barometer.	
	Maximum.		Minimum.		Dry Bulb.		Wet Bulb.			
	9 A.M.	9 P.M.	9 A.M.	9 P.M.	9 A.M.	9 P.M.	9 A.M.	9 P.M.	9 A.M.	9 P.M.
1	76	80	71	75	76·5	75·5	73	72	75	76
2	76	80	73·5	75	75·5	75	73·5	72	77	77
3	76	78	72·5	74	76	75	73	70·5	77	76
4	81	83	73	74·5	80	75	72	69	78	78
5	76·5	81	72	75	76·5	75	71·5	70	77	79
6	76	80	74	75·5	76	75	71·5	71	77	77
7	76	78	72	74	75·5	75	72	71	76	76
8	76	79	73	75	77	75·5	74	73	77	77
9	76	80	74	74	76·5	75	73	73	77	77
10	74	74	73	72	74	75·5	71·5	72	76	76
11	75·5	78	71·5	71	76	73	74	71	77	76
12	76	77	72	71	76·5	75	74	73	76	77
13	76	78	73	75	75	76	73	74	76	77
14	79	82	74	77·5	79	77	76	74	78	78
15	79	83	69	75	79	76	74	71·5	79	78
16	76	76	72	73	74·5	74·5	72	72	77	77
17	78	82	73	77	78	76	74	72	77	78
18	82·5	83	73	77	81	77	73	73	79	79
19	77	78	72	72	73·5	74	72·5	72	77	77
20	81	81	71	76	81	77	76	72	79	78
21	77	78	75	74	76	75	74	75	77	77
22	78	82	72·5	75	77	77	74	73	77	78
23	82	82	73	77	79	77	75	73	79	77
24	79	81	75	76	78	77	74	73	78	78
25	81	84	72·5	76	81	76	76	73	77	78
26	82	84	73	77	82	77	77	73	78	78
27	79	78	74	74	77	76	74	72	78	77
28	86	82	73	70	78	73	75	70	77	77
29	79	81	71	70	79	71	76	68	78	78
30	80	82·5	69	75	80	76	73	73	76	78

CHRISTIANSBORG CASTLE, GOLD COAST.

October 1860.

MAXIMUM OBSERVATIONS.—*Morning*—26th and 31st, 80°; 17th and 29th, 79°; 16th, 18th, 19th, 25th, 29th, and 30th, 78°. *Noon*—27th, 83°; 29th, 82°·20; 25th and 30th, 82°; 15th, 16th, 18th, and 19th, 81°. *Evening*—25th and 30th, 79°; 20th, 78°·50.

MEDIUM OBSERVATIONS.—*Morning*—10th, 77°·10; 7th, 77°; 1st, 2nd, 5th, 9th, and 24th, 76°. *Noon*—8th, 79°·20; 1st and 5th, 79°. *Evening*—1st, 5th, 6th, and 8th, 77°.

MINIMUM OBSERVATIONS.—*Morning*—4th and 6th, 75°. *Noon*—3rd, 76°. *Evening*—3rd, 76°.

Remarks.—Rained on the 1st, 2nd, 9th, 10th, 11th, 17th, 18th, 20th, 23rd, and 24th, at night; on the 3rd and 17th, in the day. Drizzled in the afternoon of the 6th. Lightning, 1st, N.W.; 5th, N.E. and S.W.; 6th, W.N.W.; 7th, N.; 8th, N.E., vivid, S., and S.W.; 9th, W.N.W., E.N.E., and afterwards general; 10th and 11th, E.N.E.; 13th and 16th, S.W. by S. to W.; 24th, N.E.; 25th, W.S.W. and N.E.; 27th, S.S.W.; 28th, N.; 31st, W. and N.W. Thundered on the 10th. Wind on the 7th was S.W.; 8th, S. and S.W.; continued so all the month in the afternoon—in the morning was N. and S.W. A rainbow appeared on the 13th, the ends respectively were seen at N.W. by W. $\frac{1}{3}$ W. and S.W. by S. $\frac{3}{4}$ S. There were no clouds in the evenings of the 7th and 27th.

River Gambia.

October 1863.

Maximum Observations.—*Morning*—2nd, 82°; 14th and 15th, 81°. *Noon*—14th, 93°; 13th and 31st, 92°. *Evening*—13th and 14th, 94°; 2nd, 12th, 15th, 24th, and 31st, 93°.

Medium Observations.—*Morning*—4th, 7th, 18th, 22nd, 24th, 26th, 27th, and 28th, 78°; 5th, 77°. *Noon*—4th, 7th, and 28th, 87°; 18th, 29th and 30th, 86°. *Evening*—16th, 29th, and 30th, 88°.

Minimum Observations.—*Morning*—17th, 29th, and 30th, 74°. *Noon*—17th, 82°. *Evening*—10th, 81°.

Remarks.—Rained on the 9th and 10th, with thunder; afternoon of the 17th, all night. Tornado on the 9th, 16th, 17th, and 26th at 5 p.m. The wind was from N.W. to S.; strong N.E. wind all day of the 31st. The 12th and 13th were the hottest days in the month, the thermometer at 3 p.m. being 95°.

October 1865.

Maximum Observations.—*Morning*—1st, 3rd, 7th, and 21st, 82°; 6th and 22nd, 81°. *Noon*—21st and 22nd, 90°; 1st, 3rd, 6th, 20th, 23rd, and 28th, 89°. *Evening*—20th and 22nd, 94°; 6th, 19th, 21st, and 28th, 93°.

Medium Observations.—*Morning*—4th, 9th, 14th, 15th, 23rd, 24th, 25th, and 29th, 78°. *Noon*—5th, 13th, 14th, 18th, 26th, and 27th, 88°. *Evening*—15th, 87°.

Minimum Observations.—*Morning*—30th, 75°. *Noon*—2nd, 4th, 8th, 10th, and 31st, 86°. *Evening*—16th, 82°.

Remarks.—Rained at night on the 2nd, 4th, 9th, 15th, and 16th.

Tornado, with rain, on the 15th and 16th; without rain on the 22nd. Foggy in the morning of the 12th and 30th. Cloudy, 22nd and 31st. Fine the rest of the time. The average morning thermometrieal register was 79°·16; noon, 87°·43; evening, 90°·63; the mean register of the month was 84°·89.

THERMOMETRICAL OBSERVATIONS FOR 1862, 1863, 1864, 1865.
RIVER GAMBIA.

DAYS.	1862.			1863.			1864.			1865.		
	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.
1	76	84	88	80	90	92	79	88	90	82	89	92
2	78	88	89	82	90	93	...	...	91	77	86	89
3	78	90	92	80	89	91	78	...	90	82	89	91
4	80	86	91	78	87	89	82	...	91	78	86	89
5	81	88	91	77	88	90	81	89	91	79	88	91
6	82	86	91	80	88	90	82	92	93	81	89	93
7	80	86	90	78	87	89	83	92	...	82	...	...
8	82	84	90	79	88	90	82	90	93·5	79	86	90
9	78	88	91	80	88	89	79	88	87	78	87	89
10	78	88	92	80	89	81	80	...	89	79	86	90
11	83	89	92	75	88	91	82	89	90	80	87	91
12	82	87	90	80	91	93	78	86	78	79	87	92
13	81	88	90	82	92	94	75	...	...	80	88	91
14	78	89	92	81	93	94	80	87	88	78	88	92
15	80	90	92	81	91	93	78	87	87	78	86	87
16	79	90	93	80	89	88	78	...	90·5	76	82	82
17	84	90	92	74	82	87	79	89	91·5	79	87	91
18	80	88	92	78	86	89	79	...	89	80	88	90
19	80	87	90·30	80	88	90	80	90	93	80	87	93
20	80	88	92	79	88	90	81	91	...	80	89	94
21	78	88	92	76	88	90	80	...	93·5	82	90	93
22	80	89	92	78	90	91	81·5	90	92·5	81	90	94
23	74	84	91	75	90	92	82·5	90	...	78	89	91
24	80	86	90	78	90	93	79	90	84	78	87	89
25	78	88	90	80	90	93	75·5	88	89	78	87	91
26	74	85	90	78	89	92	78	89	87·5	79	88	91
27	76	87	90	78	88	90	79	90	89	80	88	92
28	76	86	90	78	87	90	79	87·5	...	79	89	93
29	82	88	90	74	86	88	80	88	91	78	87	89
30	75	88	89	74	86	88	79	89	89·5	75	87	90
31	74	86	88	75	92	93	79	88	92	79	86	89

In 1820, at Freetown, Sierra Leone, the *maximum* thermal register in October was 83°; the *medium*, 80°; and the *minimum*, 78°. During the day the weather was fine, but hot and sultry, and there were several heavy rains at night.

Sierra Leone.

October 1860.

Maximum and Minimum Thermometers.

Highest Maximum Observations.—At 9 a.m.—20th, 89°; 15th, 87°·5. At 3 p.m.—20th, 88°; 25th, 86°. At 9 p.m.—12th and 15th, 84°.

Lowest Maximum Observations.—At 9 a.m.—6th and 28th, 76°. At 3 p.m.—6th, 76°. At 9 p.m.—6th, 9th, 17th, and 28th, 77°.

Highest Minimum Observations.—At 9 a.m.—16th, 78°; 10th, 76°; 19th, 20th, and 25th, 75°. At 3 p.m.—20th, 85°; 31st, 84°. At 9 p.m.—11th, 12th, 15th, 20th, 78°; 2nd, 3rd, 4th, 8th, 9th, 10th, 18th, 22nd, 26th, and 31st, 77°.

Lowest Minimum Observations.—At 9 a.m.—11th, 66°. At 3 p.m.—28th, 70°. At 9 p.m.—23rd, 68°.

Dry and Wet Bulb Thermometers.

Maximum Dry Bulb Thermometer.—At 9 a.m.—4th and 31st, 85°; 12th, 20th, 25th, and 30th, 84°. At 3 p.m.—20th and 31st, 85°; 15th, 84°. At 9 p.m.—10th, 11th, 12th, and 20th, 78°.

Minimum Dry Bulb Thermometer.—At 9 a.m.—28th, 71°. At 3 p.m.—6th, 76°. At 9 p.m.—23rd, 68°.

Maximum Wet Bulb Observations.—At 9 a.m.—4th, 78°. At 3 p.m.—15th, 18th, and 20th, 77°. At 9 p.m.—3rd, 4th, 8th, 9th, 10th, 12th, and 14th, 74°.

Minimum Wet Bulb Observations.—At 9 a.m.—11th, 71°. At 3 p.m.—5th and 21st, 73°. *Evening*—29th, 65°.

Remarks.—Thundered on the 3rd, 5th, 6th, 7th, 9th, 11th, 13th, 14th, 15th, 17th, 18th, 21st, 23rd, and 25th. Tornado on 4th, at 3 p.m.; 8th, at 3 p.m.; 10th, at 11 p.m.; 11th, at 11 p.m.; 13th, at 8 p.m.; 16th, at 2 a.m.; 17th, at 2 p.m.; 19th, at 5 p.m.; 22nd, at 12 noon; 23rd, at 4 a.m.; 25th, at 5 p.m.; 29th, at 7 p.m. No rain (day or night) on the 10th, 18th, 19th, 20th, 21st, 22nd, and 25th.

Thermometrical Observations for 1860. Sierra Leone.

Days.	Maximum and Minimum Thermometers.						Wet and Dry Bulb Thermometers.						Thermometer of Barometer.		
	Maximum.			Minimum.			Dry Bulb.			Wet Bulb.					
	9 A.M.	3 P.M.	9 P.M.	9 A.M.	3 P.M.	9 P.M.	9 A.M.	3 P.M.	9 P.M.	9 A.M.	3 P.M.	9 P.M.	9 A.M.	3 P.M.	9 P.M.
1	78	81	79	73	76	75	77	80	76	75	75	72	78	78	78
2	79	82	82	73	79	77	79	80	77	76	76	73	77	78	78
3	79	81	81	74	78	77	78·5	79	77	75	75	74	77	78	78
4	85	85	79	73	79	77	85	79	77	78	74	74	78	81	79
5	78	80	78	71	77	74	78	77	76	74	73	73	78	78	78
6	76	76	77	70	72	74	72	76	75	70	73·5	73	76	76	77
7	84	83	82	72·5	78	75	80	80	76	75	74	72	77	77	78
8	82·5	82	81	73	78	77	79	79	77	74	75	74	77	79	78
9	79	82	77	73	78	77	79	80	77	74	75	74	74	75	74
10	79	82	81	76	79	77	79	80	78	75	76	74	78	78	78
11	82	84	83	66	79	78	77	83	78	71	75	73	77	79	78
12	84	83	84	73	81	78	84	82	78	77	75	74	79	79	79
13	79	83	78	69	76	74	77	78	75	73	74	71	77	78	77
14	77·5	80	79	73	77	75	78	79	77	75	75	74	77	78	77
15	87·5	85	84	74	80	78	82	84	79	75	77	73	80	81	79
16	84	79	79	78	78	75	80	78	75	76	74·5	72	77	78	78
17	78	82	77	73	77	75	78	77	75	75	74	72	78	79	78
18	81·5	83	81	72	81	77	81	82	75	75	74	72	78	79	78
19	84	84	82·5	75	79	75	84	85	78	75	76	70	79	79	78
20	89	88	85	75	85	78	81	79	77	77	77	71	80	81	80
21	83	82	81	74	78	76	82·5	81	77	75	73	71	78	79	78
22	84	84	80	74	77	77	79	80	68	76	74	70	80	81	80
23	80	82	80	70	80	68	81	83	76	73	74	63	77	78	77
24	82	85	82	69	81	76	84	81·5	76	71	74	68	77	78	77
25	85	86	82	75	82	72	80	80	77	77	75	68	79	80	78
26	80	80	79	71	78	77	77	80	76	75	75	72	77	78	77
27	78	81	80	71	78	76	71	77	77	73	76	71	77	78	78
28	76	78	77	70	70	75	80	82	75	75	74	70	76	77	77
29	83	83	83	72	81	72	81	81	72	74	74	65	77	78	77
30	84	84	82	72	82	76	84	83	76	76	75	68	79	78	77
31	85	85	85	74	84	77	85	85	77	76	76	68	78	79	78

Gold Coast.

November 1859.

Maximum Observations.—*Morning*—10th, 18th, 20th, 21st, and 23rd, 80°; 16th, 17th, 19th, 24th, and 27th, 79°. *Noon*—17th, 84°. *Evening*—24th, 82°.

Medium Observations.—*Morning*—12th, 14th, and 15th, 78°. *Noon*—9th and 24th, 83°. *Evening*—11th, 24th, and 27th, 80°.

Minimum Observations.—*Morning*—29th, 76·50°. *Noon*—13th, 15th, 16th, and 23rd, 82°. *Evening*—14th, 27th, and 28th, 72°.

Remarks.—Tornado on the 11th, 15th, and 16th. Very severe storms on the 28th, at 3.30 A.M. to 5 A.M., accompanied by vivid flashes of lightning and tremendous roar of thunder. On the 17th severe flashes of lightning towards E.S.E.; at 10 P.M. the atmosphere was highly charged with electricity, and there were many shooting stars.

River Gambia.

November 1865.

Maximum Observations.—*Morning*—1st and 12th, 81°; 11th, 15th, and 16th, 80°. *Noon*—23rd and 24th, 91°; 9th, 10th, and 14th, 90°. *Evening*—9th, 10th, 13th, 14th, 23rd, and 24th, 94°; 2nd, 3rd, 11th, 12th, and 25th, 93°.

Medium Observations.—*Morning*—3rd, 4th, 5th, 6th, 14th, 19th, 23rd, 24th, and 26th, 75°; 18th, 74°. *Noon*—17th and 19th, 86°; 5th and 28th, 85°. *Evening*—19th, 20th, and 22nd, 89°.

Minimum Observations.—*Morning*—30th, 67°. *Noon*—30th, 81°. *Evening*—8th, 26th, and 30th, 86°.

Remarks.—Harmattan commenced to blow on the 2nd. The mornings are always foggy, especially over the river; but the days fine, a few cloudy. There was slight tornado and rain on the 16th, at 5 P.M. The average thermometric register in the morning was 75°·3; at noon, 86°·8; and in the evening, 90°·63. The mean of the month was 82°·96.

November 1863.

Maximum Observations.—*Morning*—3rd, 81°; 5th, 80°. *Noon*—8th and 10th, 93°. *Evening*—2nd, 95°; 4th, 5th, 7th, 8th, 9th, 11th, 16th, 18th, and 19th, 94°.

Medium Observations.—*Morning*—1st, 6th, 7th, 8th, 10th, and 12th, 76°; 2nd, 9th, and 13th, 75°. *Noon*—9th and 29th, 87°; 30th, 85°. *Evening*—29th, 90°.

Minimum Observations.—*Morning*—16th, 25th, 26th, 27th, 28th, and 30th, 70°. *Noon*—28th, 82°·30. *Evening*—3rd, 86°.

Remarks.—Most of the days were cloudy. There was dense fog on the 11th, from daylight till 7 P.M. In the early part of the month the days were very hot; hot winds from N.W. On the 11th the harmattan commenced to blow. The weather was generally cloudy. In 1862 the thermometer went up during this month to 98° on the 16th.

THERMOMETRICAL OBSERVATIONS FOR 1862, 1863, 1864, 1865.
RIVER GAMBIA.

DAYS.	1862.			1863.				1864.			1865.		
	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	Highest diurnal temp.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.
1	74	87	90	76	91	93	93	79	92	90	81	88	91
2	74	88	92	75	90	94	95	78	93	89	77	87	93
3	78	88	91	81	84	86	86	79	80	87	75	89	93
4	77	90	92	78	90	93	94	79	90	88	75	88	91
5	78	90	92	80	91	94	94	79	85	87	75	85	91
6	74	90	92·30	76	91	93	93	76	9	89	75	87	92
7	74	89	93	76	92	94	94	77	84	83	78	87	91
8	74	86	91	76	93	93	94	80	89	87	78	83	86
9	76	88	93	75	87	94	94	77	86	86	77	90	94
10	76	90	94	76	93	91	93	79	91	86	77	90	94
11	74	90	92	74	90	94	91	82	...	86	78	90	94
12	72	85	88	76	89	92	92	82	94	85	80	89	93
13	70	84	88	75	88	90	91	80	93	85	81	89	93
14	75	86	87	71	90	91	92	75	92	86	19	89	94
15	75	88	89	74	88	90	90	76	91	85	75	90	94
16	80	88	98	70	92	94	94	77	87	87	80	88	91
17	72	82	82	73	90	93	93	76	92	88	80	88	91
18	77	90	82	72	92	94	94	...	...	...	77	86	91
19	78	86	90	73	92	93	94	78	90	88	74	87	91
20	74	85	86	72	88	92	93	77	89	87	75	86	89
21	70	80	81	72	90	93	93	77	89	86	71	84	89
22	68	80	82	73	89	92	92	78	87	86	71	83	87
23	68	81	81	72	90	92	92	77	87	85	72	87	89
24	67	80	82	72	92	93	93	77	87	85	75	91	94
25	69	84	84	70	90	92	92	74	87	85	75	91	94
26	70	86	87	70	89	92	93	74	88	86	76	87	93
27	72	86	88	70	88	93	93	72	87	85	75	84	86
28	74	85	86	70	82·30	92	93	74	88	85	71	83	87
29	76	86	88	71	87	90	90	...	...	...	70	85	88
30	73	84	86	70	85	87	87	74	87	86	68	82	87

In 1820, at Freetown, Sierra Leone, the *maximum* thermometrical register was 83°; the *medium*, 81°; the *minimum*, 79°. There were a few tornadoes during the month. There was no harmattan wind.

GOLD COAST.

December 1859.

MAXIMUM OBSERVATIONS.—*Morning*—16th and 23rd, 82°; 5th, 11th, 12th, 14th, 18th, and 19th, 81°. *Noon*—6th, 10th, 15th, and 29th, 84°. *Evening*—14th, 84°.

MEDIUM OBSERVATIONS.—*Morning*—3rd, 9th, and 10th, 80°. *Noon*—9th, 83°·30. *Evening*—10th, 83°.

MINIMUM OBSERVATIONS.—*Morning*—1st and 2nd, 77°. *Noon*—4th, 81°. *Evening*—5th, 82°·25.

Remarks.—Thundered on the 21st, 28th, and 29th; on the 21st it was very severe and stormy towards E.S.E. at 12 A.M. Very hot and sultry on the 4th, 7th, 10th, and 15th. The evenings generally during the month were very windy—wind S.W. Cloudy on the 4th at 10.30 P.M; on the 8th, E. at 7 P.M., and then drifted to E.N.E.; 14th, at night; 23rd, zenith from 9.30 to 10.45 A.M.; 28th, evening; 29th, day. Much lightning towards N.E. by E. on the 7th, between 7 and 9 P.M.; land breeze all the day on the 8th.

River Gambia.

December 1865.

Maximum Observations.—*Morning*—14th, 76°; 13th, 74°. *Noon*—7th, 88°; 2nd and 16th, 87°. *Evening*—2nd, 92°; 7th, 15th, and 16th, 91°.

Medium Observations.—*Morning*—3rd, 8th, 12th, 17th, 18th, and 19th, 69°; 29th, 68°. *Noon*—1st, 4th, 8th, 14th, and 17th, 83°; 19th, 81°. *Evening*—3rd, 87°; 17th, 86°.

Minimum Observations.—*Morning*—22nd, 63°. *Noon*—13th, 21st, 22nd, 27th, and 29th, 77°. *Evening*—13th, 79°.

Remarks.—Harmattan blew every day but two. There was dense fog on the mornings of the 9th and 11th; a few drops of rain on the 28th. The average thermometrical register for the month was 69° in the morning, 81°·58 at noon, and 86°·06 in the evening; the mean of the month was 77°·5.

Thermometrical Observations for 1862, 1863, 1864, 1865.
River Gambia.

Days.	1862.			1863.				1864.			1865.		
	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.	Highest diurnal temp.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.
1	70	84	84	79	86	92	93	72	88	89	70	83	88
2	69	84	85	70	81	90	92	70	86	88	70	87	93
3	70	87	88	70	88	92	92	69	86	88	69	84	87
4	72	84	86	72	91	90	91	69	88	86	70	83	88
5	72	84	87	74	87	90	93	72	87	87	70	...	...
6	68	83	87	74	90	93	93	68	...	...	71	84	90
7	67	82	84	72	87	95	95	68	86	89	70	86	91
8	68	84	86	68	86	90	90	69	85	86	69	83	88
9	70	84	87	76	88	92	92	69	83	86	67	84	90
10	72	82	84	78	86	86·30	86·30	69	86	87	71	85	89
11	70	80	83	78	85	88	90	69	86	88	70	80	85
12	72	79	82	68	87	87	87	69	85	89	69	80	84
13	70	83	84	70	87	86	87	71	90	93	74	77	79
14	72	84	85	68	86	80	88	71	90	93	76	83	85

Thermometrical Observations for 1862–1865—*continued.*

Days.	1862.			1863.				1864.			1865.		
	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	7 P.M.	Highest diurnal temp.	7 A.M.	Noon.	4 P.M.	7 A.M.	Noon.	4 P.M.
15	72	83	84	68	86	88	88	69	87	93	71	85	91
16	68	84	86	67	88	88	88	70	90	92	71	87	91
17	74	85	87	68	89	90	90	72	86	91	69	83	86
18	72	85	86	65	85	88	88	73	88	92	69	84	88
19	70	76	80	66	88	86	88	72	90	94	69	81	84
20	65	78	80	70	89	89	89	73	89	94	66	80	83
21	70	80	82	73	93	93	94	68	89	94·30	65	77	83
22	72	82	85	77	95	95	95	68	88	93	63	77	83
23	72	78	80	75	92	...	...	66	86	88	65	80	85
24	73	80	81	72	85	...	...	67	85	88	65	79	85
25	73	80	81	70	81	...	...	68	86	89	64	80	84
26	72	84	86	70	84	...	...	76	89	94	64	80	84
27	72	80	84	68	84	86	...	76	89	94	67	77	83
28	69	80	82	73	87	...	...	74	89	92	65	79	84
29	68	80	84	78	90	92	...	72	89	92	68	77	82
30	69	81	83	71	89	92	...	71	90	94	70	80	85
31	70	82	84	66	88	...	...	73	93	94·30	72	79	85

In 1820, the *maximum* thermal observation at Freetown, Sierra Leone, in December, was 85°; the *medium*, 83°; and the *minimum*, 77°; the harmattan blew most of the time.

Average Weekly Thermometrical Register from April to June, 1860. Sierra Leone.

No.	Week ending.	Thermometer.			Weather.
		Max.	Med.	Min.	
1	5th April.	84	79·8	77	Fine.
2	12th April.	...	...	...	Fine.
3	19th April.	...	...	...	Wet.
4	26th April.	...	...	...	Wet and cloudy.
5	3rd May.	...	...	...	Wet.
6	10th May.	84	77·6	72	Wet.
7	17th May.	82	76·6	70	Wet.
8	24th May.	85	77	67	Wet.
9	31st May.	84	78	70	Wet.
10	7th June.	84	77·5	67	Wet.
11	14th June.	83	76·9	70	Wet.
12	21st June.	82	76·5	71	Wet.
13	28th June.	82	76·1	68	Wet.

THERMOMETRICAL OBSERVATIONS TAKEN AT MILITARY HOSPITAL, ST MARY'S, BATHURST, FOR THE MONTH OF JANUARY 1866.

DAYS.	Maximum and Minimum Thermometers.												Mean Daily.	Maximum Daily.	Minimum Daily.	Daily Range.
	7 A.M.				Noon.				4 P.M.							
	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.				
1	70	65	67	69	90	65	76	80	90	75	73	75	75·83	90	65	25
2	88	60	64	71	88	61	77	84	94	60	76	80	75·15	94	60	34
3	89	60	69	78	94	74	75	85	92	73	75	84	80·3	94	60	34
4	70	67	65	69	85	67	77	82	86	67	73	76	73·87	86·5	67	19·5
5	67	66	60	67	90	86	72	86	92	79	73	75	80·8	92	66	26
6	92	61	61	67	91	66	69	80	91	61	70	75	72	92	61	31
7	68	65	60	65	80	68	66	77	84	68	68	74	72·16	84	65	19
8	82	64	63	65	82	64	66	76	82	64	67	73	73	82	64	18
9	83	64	64	67	82	64	69	75	82	64	67	72	73·16	83	64	17
10	82	63	62	65	88	60	65	70	78	72	61	71	73·66	88	60	28
11	72	62	61	64	72	65	70	73	71	69	70	73	68·83	72	62	10
12	72	63	62	64	74	64	71	75	82	75	73	75	71·66	82	63	19
13	84	60	62	67	90	65	70	76	85	64	67	75	74·91	90	64·75	25·25
14	80	63	58	65	83	72	65	75	71	65	64	68	72·33	83	63	20
15	84	63	58	65	90	63	64	81	90	63	74	78	70·66	90·5	63	27·5
16	91	63	60	66	92	63	74	83	92	63	73	80	77·67	92·5	63	29·5
17	93	62	62	67	93	63	61	85	93	62	73	75	77·91	93·5	62	31·5
18	94	62	56	65	93	62	75	84	93	63	78	85	72·83	94	62	33
19	92	63	60	65	93	61	74	76	93	62	75	81	77·33	93	61	32
20	93	64	55	62	93	59	72	76	93	59	71	75	71·83	93	59	34
21	94	62	60	66	86	75	78	85	81	71	75	83	76·5	94	62	32
22	99	74	65	69	93	61	76	85	93	62	75	85	80·58	99·5	61	38·5
23	92	65	69	71	93	59	72	78	81	59	75	85	74·91	93	59	34
24	94	64	62	74	93	59	74	76	84	62	73	80	76	94	59	35
25	92	65	69	71	93	75	74	78	84	69	75	83	78·61	98	65	28
26	91	63	60	75	92	71	74	65	93	62	71	83	78·82	93	62	31
27	97	63	55	67	98	63	82	86	98	63	72	85	80·41	98	63	35
28	92	61	59	70	98	71	76	85	93	71	75	83	81·20	98	61·5	36·5
29	92	65	60	74	92	62	75	89	97	61	77	84	78·53	97·75	61·75	36·75
30	91	65	60	74	90	83	74	85	94	62	73	83	80·83	94	62	32
31	97	62	62	78	92	65	71	82	94	64	62	74	79·12	97·75	62	35·75

Thermometrical Observations taken at Military Hospital, St Mary's, Bathurst, for the Month of February 1866.

Days.	Maximum and Minimum Thermometers.												Mean Daily.	Maximum Daily.	Minimum Daily.	Daily Range.
	7 A.M.				Noon.				4 P.M.							
	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.				
1	98	62	61	72	99	65	69	71	73	70	62	74	77·8	99	62	37
2	97	70	64	73	98	66	62	72	99	62	70	87	82·0	99	62	37
3	98	63	61	70	98	82	61	80	99	65	65	84	84·1	99	63	36
4	97	70	64	73	99	65	69	72	98	70	62	73	83·1	99	65	34
5	99	66	64	72	97	66	68	73	89	63	71	87	80·0	99	63	36
6	94	63	63	71	96	72	63	74	100	65	72	86	81·6	100	63	37
7	99	70	60	71	97	65	62	72	99	66	70	73	82·6	99	65	34
8	100	65	64	73	99	66	68	81	101	63	67	81	82·3	101	63	38
9	99	70	63	72	96	64	67	76	101	63	70	86	82·1	101	63	38
10	97	71	57	67	98	65	63	72	101	63	65	73	82·4	101	63	38
11	98	66	60	70	97	65	68	81	100	65	70	86	81·8	100	65	35
12	101	63	61	72	101	63	70	86	101	63	81	82	82	101	63	38
13	99	71	63	71	97	64	69	83	97	64	81	79	82·1	99	64	35
14	98	65	64	70	100	64	82	97	100	65	70	86	81·9	100	64	36
15	99	66	60	70	100	64	69	83	100	64	81	79	83·8	100	64	36
16	101	63	65	71	97	64	69	86	101	64	81	79	81·6	101	63	38
17	99	65	64	70	98	63	69	81	97	63	70	73	80·8	99	63	36
18	98	71	63	72	96	64	68	82	100	63	82	78	82	98	63	35
19	99	63	64	72	97	65	81	86	101	65	72	73	81·6	101	63	38
20	99	71	60	70	97	63	74	97	100	65	70	79	82·6	100	63	37
21	99	63	62	72	98	64	83	72	101	66	73	78	81·8	101	63	38
22	99	71	64	73	97	64	81	86	100	65	72	74	82·6	100	64	36
23	98	71	63	70	98	65	82	71	101	66	73	71	83·1	101	65	36
24	99	72	64	70	97	63	82	76	100	65	71	82	82·6	100	63	37
25	98	70	63	76	99	64	81	72	101	63	72	73	82·4	101	63	38
26	99	66	64	72	99	64	81	76	100	62	76	81	82·3	101	63	38
27	99	66	64	72	99	64	81	76	100	62	76	81	81·6	100	62	38
28	98	64	65	72	98	64	82	76	101	64	73	83	82·5	101	64	37

Thermometrical Observations taken at Military Hospital, St Mary's, Bathurst, for the Month of March 1866.

Days.	Maximum and Minimum Thermometers.												Mean Daily.	Maximum Daily.	Minimum Daily.	Daily Range.
	7 A.M.				Noon.				4 P.M.							
	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.				
1	99	66	64	73	98	82	61	72	100	65	70	73	85·2	100	65	35
2	98	72	63	71	99	81	63	70	101	64	71	76	85·9	101	64	37
3	98	71	63	72	88	70	62	71	100	61	70	72	81·3	100	61	39
4	99	60	61	73	81	71	63	72	100	62	68	69	77·8	100	60	40
5	97	60	68	70	82	70	61	71	100	60	63	70	78·1	100	60	40
6	99	62	64	75	82	73	62	70	101	61	62	70	74·6	101	61	40
7	98	64	60	71	90	70	61	73	100	63	79	80	80·8	100	63	37
8	80	70	62	70	83	71	62	70	100	61	71	80	77·4	100	61	39
9	99	64	60	71	84	70	62	71	99	60	71	81	78·8	99	60	39
10	99	63	61	70	80	70	61	70	100	61	72	82	78·8	100	61	39
11	88	60	61	72	81	70	63	72	100	60	72	81	76·4	100	60	40
12	98	71	70	79	88	72	63	70	99	65	69	74	82·6	99	65	34
13	90	65	60	67	80	70	73	71	100	65	65	74	78·3	100	65	35
14	99	68	70	61	84	72	64	70	101	64	64	71	81·3	101	64	37
15	88	60	71	62	89	70	63	72	100	63	60	70	48·3	100	60	40
16	97	64	72	60	83	71	65	70	100	60	62	71	79·1	100	60	40
17	99	70	63	79	80	70	65	72	100	61	64	70	80·0	100	61	39
18	98	70	60	70	81	70	64	71	101	60	63	70	84·9	101	60	41
19	98	71	60	71	80	72	65	70	101	63	60	71	82·8	101	63	38
20	99	63	70	72	83	70	63	71	100	60	61	70	79·1	100	60	40
21	105	72	61	67	80	72	62	70	99	60	68	76	81·1	105	60	45
22	99	70	70	63	80	72	60	71	98	60	64	70	79·8	99	60	39
23	99	70	62	67	83	72	70	61	100	60	63	71	80·6	100	60	40
24	99	70	61	72	80	70	60	72	101	60	63	70	79·9	101	60	41
25	86	72	63	70	90	70	60	70	101	62	60	70	81·1	101	62	39
26	99	72	60	71	90	74	63	71	108	66	60	70	84·8	108	66	42
27	97	70	64	74	90	70	62	70	106	60	61	70	82·1	106	60	46
28	99	72	60	71	90	71	63	70	100	61	63	71	80·4	100	61	39
29	88	63	60	72	99	70	62	71	100	63	60	70	82·1	100	63	37
30	89	61	60	70	98	72	60	71	100	60	61	72	79·9	100	60	40
31	99	60	60	74	80	71	60	71	100	60	60	72	79·1	100	60	40

THERMOMETRICAL OBSERVATIONS TAKEN AT MILITARY HOSPITAL, ST MARY'S, BATHURST, FOR THE MONTH OF APRIL 1866.

DAYS.	Maximum and Minimum Thermometers. 7 A.M.				Noon.				4 P.M.				Mean Daily.	Maximum Daily.	Minimum Daily.	Daily Range.
	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.				
1	89	80	65	67	80	72	60	65	107	62	70	72	...	...	...	...
2	88	76	63	66	76	60	64	66	100	60	71	74	...	...	...	...
3	89	70	64	68	70	63	60	64	102	63	70	76	...	...	...	...
4	88	73	60	61	72	60	62	69	100	60	72	70	...	...	...	...
5	80	86	65	60	80	62	70	80	106	61	72	73	...	...	...	...
6	83	79	63	66	78	60	71	82	100	60	70	74	...	...	...	...
7	82	70	60	63	79	64	70	80	99	63	72	76	...	...	...	...
8	89	70	64	66	88	64	71	80	101	60	70	74	...	...	...	...
9	88	60	62	68	80	66	76	79	100	63	71	76	...	...	...	...
10	89	64	68	70	86	60	73	77	101	65	69	70	...	...	...	...
11	99	66	66	70	82	62	70	76	102	62	67	71	...	...	...	...
12	99	68	64	71	88	64	76	79	100	60	70	76	...	...	...	...
13	88	67	60	70	77	60	62	70	102	60	61	77	...	...	...	...
14	99	70	60	73	81	60	62	71	106	60	70	72	...	...	...	...
15	99	76	61	70	86	66	60	70	102	63	71	76	...	...	...	...
16	80	72	60	69	88	60	61	70	101	66	70	78	...	...	...	...
17	80	70	61	68	84	62	60	72	106	60	61	70	...	...	...	...
18	89	71	60	64	82	60	62	70	101	60	66	70	...	...	...	...
19	88	70	63	65	88	64	60	71	101	66	60	76	...	...	...	...
20	99	70	60	66	89	60	70	76	105	69	70	74	...	...	...	...
21	99	76	60	63	89	64	73	76	103	60	71	76	...	...	...	...
22	99	70	60	66	88	63	71	76	100	63	70	72	...	...	...	...
23	88	76	66	70	86	64	72	79	107	60	70	79	...	...	...	...
24	88	70	67	74	89	66	70	76	106	66	70	77	...	...	...	...
25	88	76	60	70	88	60	70	79	103	65	72	76	...	...	...	...
26	90	70	66	70	89	64	72	77	106	65	70	76	...	...	...	...
27	99	77	67	70	89	60	76	78	107	65	76	78	...	...	...	...
28	99	77	69	70	88	65	72	76	105	60	72	76	...	...	...	...
29	90	76	60	70	89	60	71	76	106	60	71	77	...	...	...	...
30	99	76	66	78	86	65	70	74	108	60	60	72	...	...	...	...

THERMOMETRICAL OBSERVATIONS TAKEN AT MILITARY HOSPITAL, ST MARY'S, BATHURST, FOR THE MONTH OF MAY 1866.

DAYS.	Maximum and Minimum Thermometers.												Mean Daily.	Maximum Daily.	Minimum Daily.	Daily Range.
	7 A.M.				Noon.				4 P.M.							
	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.				
1	86	68	60	67	89	74	74	85	99	70	60	58	80·9	99	70	29
2	88	60	63	66	80	66	70	83	80	67	66	60	73·4	88	60	28
3	90	66	60	64	88	68	62	67	86	76	65	67	79	90	66	24
4	76	70	63	60	80	64	60	66	89	76	61	65	73·3	89	61	28
5	69	65	60	63	82	70	68	70	98	70	63	67	70·6	98	65	23
6	77	69	63	68	81	71	64	66	90	73	60	67	71·8	90	69	21
7	78	63	62	63	80	70	63	65	88	72	61	66	70·1	88	63	25
8	76	66	61	66	86	70	60	64	99	70	60	67	76·1	99	70	29
9	77	64	60	64	88	69	63	66	86	70	63	68	75·6	88	64	24
10	88	67	63	66	89	72	61	63	99	72	60	66	76·3	99	67	32
11	75	60	62	64	87	68	63	67	86	70	61	64	74·3	87	60	27
12	88	64	63	66	88	60	62	64	88	70	73	66	76·3	88	60	28
13	76	60	63	65	87	62	63	66	86	70	66	69	73·5	87	60	27
14	77	62	60	66	89	63	65	67	87	72	60	66	73	89	62	27
15	80	63	65	67	80	62	60	66	90	67	63	66	73·6	90	62	28
16	96	69	68	72	88	64	62	66	99	70	62	64	80·9	99	64	35
17	99	60	63	66	86	60	65	68	90	70	63	65	79·1	99	60	39
18	96	63	60	64	84	62	64	66	89	68	64	66	77·6	96	62	34
19	96	60	62	66	86	60	65	67	98	66	62	64	77·1	98	60	38
20	99	62	61	64	81	64	63	65	96	70	68	67	78·6	99	62	37
21	89	61	60	62	88	63	62	63	89	63	60	64	75·4	89	61	28
22	88	63	64	66	86	60	66	68	88	66	65	68	75·1	88	60	28
23	86	64	62	63	84	64	62	64	98	64	62	66	76·6	98	64	34
24	87	60	62	64	82	63	61	63	95	70	75	67	76·1	95	60	35
25	88	65	60	62	81	62	64	66	90	72	60	63	76·2	90	62	28
26	86	64	63	63	83	63	64	68	88	67	66	69	75·1	88	63	35
27	89	62	63	65	85	64	62	64	86	70	64	67	76·9	89	62	27
28	86	60	71	75	84	60	63	66	98	72	66	68	76·6	98	60	38
29	87	63	73	72	86	66	60	65	99	66	60	64	79·4	99	63	36
30	85	64	70	76	88	65	65	66	99	67	66	69	77·9	99	64	35
31	86	60	72	75	85	60	62	64	98	60	64	68	79·8	98	60	38

THERMOMETRICAL OBSERVATIONS TAKEN AT MILITARY HOSPITAL, ST MARY'S, BATHURST, FOR THE MONTH OF JUNE 1866.

DAYS.	Maximum and Minimum Thermometers.												Mean Daily.	Maximum Daily.	Minimum Daily.	Daily Range.
	7 A.M.				Noon.				4 P.M.							
	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.				
1	89	60	63	65	80	71	60	65	98	65	60	66	75·5	98	60	38
2	88	63	73	75	86	70	63	66	90	72	62	66	78·6	90	63	27
3	89	60	78	74	88	71	60	64	98	68	60	65	84·3	98	60	38
4	88	63	70	76	86	70	61	66	98	62	60	66	77·8	98	62	36
5	86	60	61	62	84	72	63	65	98	60	63	65	76·6	98	60	38
6	89	64	70	72	80	70	60	64	99	61	60	66	77·1	99	64	35
7	86	66	65	66	83	72	60	65	96	60	63	65	77·1	96	60	36
8	88	60	62	64	85	70	65	68	95	62	65	67	76·6	95	60	35
9	89	62	65	66	85	72	60	64	98	63	60	66	76	98	60	38
10	86	60	66	69	85	70	63	66	96	60	62	66	75	96	60	36
11	88	63	60	66	88	72	64	65	98	64	60	64	78·8	98	63	35
12	87	62	65	67	80	71	62	64	95	62	63	66	76·1	95	62	33
13	89	60	62	64	82	73	60	66	97	63	64	65	77·2	97	60	37
14	88	62	60	63	85	70	61	64	96	60	63	65	75·8	96	60	36
15	86	63	65	60	80	72	60	63	98	65	60	64	77·2	98	63	35
16	89	60	64	68	83	69	64	66	97	63	62	65	76·8	97	60	37
17	88	62	61	64	86	68	62	64	90	62	60	62	76	90	62	28
18	85	64	60	65	84	70	63	65	97	64	61	63	77·2	92	64	33
19	86	60	62	66	88	72	60	62	96	60	63	65	77	96	60	36
20	99	78	60	62	99	75	77	91	84	62	60	61	82·8	99	62	37
21	99	73	77	86	99	78	86	95	86	60	64	66	82·4	99	60	39
22	98	70	76	80	98	73	78	85	80	63	60	65	80·2	98	63	35
23	92	72	70	80	99	70	78	80	88	60	61	64	80·1	99	60	39
24	98	90	73	99	99	78	86	95	88	73	77	80	84·2	99	70	29
25	99	72	70	97	88	70	66	70	86	70	72	76	80·8	99	70	29
26	99	90	73	78	86	71	63	72	88	73	90	99	81·1	99	70	29
27	86	66	70	...	87	70	66	72	89	72	90	76	80·1	89	66	23
28	88	60	74	78	88	71	60	75	80	70	71	75	76·1	88	60	28
29	90	63	70	76	89	72	62	74	88	72	70	77	80·5	99	63	39
30	99	60	71	76	88	70	60	76	90	70	72	76	79·4	99	60	39

THERMOMETRICAL OBSERVATIONS TAKEN AT THE MILITARY HOSPITAL, ST MARY'S, BATHURST, FOR THE MONTH OF JULY 1866.

DAYS.	Maximum and Minimum Thermometers.												Mean Daily.	Maximum Daily.	Minimum Daily.	Daily Range.
	7 A.M.				Noon.				4 P.M.							
	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.				
1	98	70	73	76	97	76	82	86	99	70	66	72	85	99	70	29
2	88	60	70	72	98	70	80	85	92	75	80	82	80·4	98	60	38
3	89	65	75	78	99	60	82	86	98	70	80	86	80·1	99	60	39
4	99	60	77	80	97	63	70	82	92	72	82	88	81·3	99	60	39
5	99	65	75	77	69	60	72	80	96	70	80	88	79·8	...	...	...
6	98	60	74	76	99	65	70	87	87	70	76	80	79·8	98	60	38
7	99	63	76	78	98	65	76	88	89	72	70	82	80·9	99	63	36
8	98	62	75	78	79	60	70	76	95	76	72	80	81·6	98	60	38
9	99	60	71	81	98	62	70	77	90	75	70	77	80·6	99	60	39
10	98	64	72	78	97	60	70	76	94	75	72	76	81·3	98	60	38
11	99	70	72	77	99	66	70	78	96	70	72	78	83·3	99	66	33
12	96	72	76	80	97	60	70	72	99	72	70	77	82·6	99	60	39
13	96	70	75	78	79	63	70	76	94	76	72	75	81·1	98	60	38
14	99	76	77	79	99	60	66	70	98	70	76	80	83·6	99	60	39
15	98	70	76	80	96	66	70	79	96	72	70	77	83·9	99	66	33
16	98	70	78	82	98	60	70	78	99	70	73	76	82·1	99	60	39
17	97	60	70	80	95	63	72	77	78	72	70	74	80·5	97	60	37
18	97	71	74	81	96	64	93	70	97	74	72	73	82·8	97	64	33
19	98	64	76	80	97	60	70	71	98	70	70	76	80·8	98	60	38
20	99	60	70	76	98	62	70	76	97	64	70	76	80	99	66	29
21	98	66	70	79	90	60	72	80	99	60	72	80	78·6	99	60	39
22	99	60	70	76	90	60	70	80	99	60	70	82	78	99	60	30
23	99	65	72	77	89	62	77	86	96	62	64	80	81·6	99	65	34
24	96	70	70	72	99	70	79	88	90	63	66	70	81·1	99	63	36
25	98	62	60	66	96	70	76	80	98	65	70	79	81·1	98	62	36
26	97	66	65	70	90	66	70	82	90	60	65	70	78·1	97	60	37
27	99	60	70	75	99	60	70	80	90	66	60	70	79	99	60	39
28	98	66	72	76	96	68	72	80	96	60	68	76	80·2	98	60	38
29	97	60	70	77	98	70	62	70	99	64	68	70	81·1	99	60	39
30	90	66	76	79	99	60	66	72	87	73	60	72	79·1	99	60	39
31	99	65	76	78	98	60	68	70	98	70	65	77	81·3	99	60	39

Thermometrical Observations taken at the Military Hospital, St Mary's, Bathurst, for the Month of August 1866.

DAYS.	Maximum and Minimum Thermometers.												Mean Daily.	Maximum Daily.	Minimum Daily.	Daily Range.
	7 A.M.				Noon.				4 P.M.							
	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.				
1	90	77	60	70	98	70	80	88	98	60	66	70	82·1	98	60	38
2	99	70	66	76	99	76	84	86	90	70	60	68	84·0	99	70	29
3	98	77	65	79	90	77	82	88	99	72	66	70	85·1	99	72	27
4	95	76	60	62	98	60	80	86	96	76	60	66	83·1	98	60	38
5	98	70	77	80	96	66	70	80	93	73	66	70	82·2	98	66	32
6	99	60	70	78	90	64	60	66	96	70	63	68	79·6	99	60	39
7	96	70	66	80	89	60	70	79	98	60	66	76	81·6	98	60	38
8	98	60	66	70	88	70	60	70	93	72	60	76	80·1	98	60	38
9	99	66	78	82	90	65	70	76	88	76	70	80	80·6	99	65	34
10	96	60	75	80	99	60	66	70	89	70	72	80	83·7	99	60	39
11	98	66	70	78	80	60	69	76	90	66	72	80	76·6	98	60	38
12	90	60	71	80	86	66	70	76	90	82	60	86	78·7	90	60	30
13	90	77	70	76	86	70	76	80	98	80	78	81	84·7	98	70	28
14	96	60	66	75	90	60	70	86	96	70	78	81	78·5	96	60	36
15	98	66	72	80	98	70	66	80	90	70	60	76	83·5	98	66	32
16	99	60	72	80	90	60	70	78	95	73	62	70	79·1	99	66	39
17	99	60	73	80	99	66	72	79	92	75	70	79	70·1	99	60	39
18	96	70	74	81	89	60	70	86	96	60	66	76	77·1	96	60	36
19	90	60	71	78	88	65	72	80	99	65	60	76	82·6	99	60	39
20	98	66	70	79	80	60	70	88	80	73	66	70	76·1	98	60	38
21	90	60	70	70	90	66	60	69	83	73	60	69	76·6	90	60	30
22	90	60	75	71	99	70	60	66	80	70	60	68	77·8	99	60	39
23	99	70	76	80	80	60	69	72	89	63	60	66	76·6	99	60	39
24	90	76	70	76	98	66	60	72	88	60	68	77	79·5	98	60	38
25	98	60	67	70	96	60	68	70	86	66	67	70	72·5	98	60	38
26	80	66	60	78	80	65	70	80	95	73	60	80	74·5	95	65	30
27	99	60	80	82	88	66	75	86	99	70	66	76	80·1	99	60	39
28	90	70	82	88	99	70	77	80	90	76	72	80	92·5	99	70	29
29	99	60	70	77	96	67	70	77	98	70	76	80	81·2	99	60	39
30	89	70	80	86	98	60	74	76	99	72	77	88	81·1	99	60	39
31	76	69	60	79	96	72	77	80	90	70	79	80	82·1	96	69	27

THERMOMETRICAL OBSERVATIONS TAKEN AT THE MILITARY HOSPITAL, ST MARY'S, BATHURST, FOR THE MONTH OF SEPTEMBER 1866.

DAYS.	Maximum and Minimum Thermometers.												Mean Daily.	Maximum Daily.	Minimum Daily.	Daily Range.
	7 A.M.				Noon.				4 P.M.							
	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.	Max.	Min.	Wet.	Dry.				
1	98	68	70	77	92	78	70	80	91	70	60	70	82·6	98	68	30
2	96	60	71	75	90	77	60	76	80	74	66	76	71·9	96	60	36
3	99	66	73	76	86	60	67	70	93	73	60	77	77·5	98	60	38
4	90	60	72	82	88	66	60	77	92	69	66	70	76·6	99	60	39
5	96	66	81	72	80	60	65	70	99	60	66	77	76·6	99	60	39
6	90	60	70	77	100	68	83	85	90	66	72	76	78·6	100	60	40
7	98	66	67	70	101	66	70	82	92	60	70	77	80·1	101	60	41
8	99	60	66	72	100	65	60	70	96	77	60	70	82·6	100	60	40
9	96	65	73	82	99	66	60	75	90	77	65	68	82·1	99	65	34
10	98	62	60	70	100	65	67	72	99	60	69	70	80·5	100	60	40
11	96	60	68	76	99	60	66	70	90	65	60	77	78·1	99	60	39
12	97	74	70	75	97	63	60	69	96	65	70	80	81·6	97	63	34
13	99	60	77	79	90	60	66	70	99	66	75	77	76·0	99	60	39
14	90	66	70	79	99	68	60	76	102	74	75	77	83·1	102	74	28
15	99	60	77	80	96	60	70	77	100	70	72	79	83·6	100	60	40
16	89	76	72	76	90	72	84	87	103	75	66	70	84·1	103	72	31
17	90	73	70	76	98	70	66	80	90	70	66	77	81·6	98	70	28
18	96	70	75	80	99	60	64	70	95	75	65	70	80·6	99	60	39
19	90	60	73	76	97	76	75	77	99	60	66	78	55·1	99	60	39
20	99	65	75	77	98	70	60	76	100	77	60	79	84·6	100	65	35
21	96	75	78	86	90	60	67	70	100	79	69	70	83·1	100	60	40
22	99	70	72	80	99	66	60	77	101	73	60	67	84·2	100	60	40
23	100	80	83	86	96	63	65	72	101	75	80	83	86·1	101	63	38
24	96	70	76	80	92	61	60	70	106	75	70	75	80·1	106	61	45
25	98	76	70	82	90	60	66	76	106	74	66	80	84·0	106	60	46
26	99	75	77	80	96	63	62	71	104	60	69	90	82·6	104	60	44
27	95	60	70	86	93	60	66	70	100	71	66	70	82·6	100	60	40
28	90	66	80	84	98	65	70	80	100	70	60	77	81·1	100	65	35
29	99	60	67	80	99	63	72	86	106	66	70	80	82·1	106	60	46
30	80	64	65	70	80	65	75	80	101	60	72	80	75·0	101	60	41

CHAPTER III.

1. THE EFFECTS OF TROPICAL HEAT ON THE GREAT NERVOUS CENTRES, AND ON THE VITAL PROCESSES OF THE INHABITANTS OF TROPICAL CLIMATES.—2. THE INTERIOR TEMPERATURE OF THE GLOBE.

THE effects of great tropical heat on the intellectual faculties of man is indeed very marked, especially when continuous; it seems, in the first place, to interfere with the regular nutrition of the cerebrum, producing a modification in the associative connections of ideational consciousness, and consequently interferes in some degree with the transmission of external expression made on that organ to the sensorium—the centre of consciousness.

One great example may be adduced from the want of success with which, in tropical climates, individuals in many cases attempt to exert the will to the recall of events which had previously been before their consciousness, but which do not at the time automatically or spontaneously present themselves in it. We very often hear the complaint, that "The heat has destroyed my memory. I cannot recollect anything." The individual fixes his attention upon ideas which had already been present in his consciousness, and places the full weight of his mind to it so as to intensify these ideas, and thus suggest and strengthen those associations which were connected with the circumstances under consideration, and yet he hesitates and bungles, and cannot give a positive and direct statement as to the facts.

The effect of this *modified nutrition,* occasioned by the constant exposure to heat, is to produce a species of absent state of the mind, a weakness of the "bond of direct association," whereby the thoughts do not so quickly develope themselves when we attempt to recall events which at some past period had produced impressions of sensational consciousness, as when the events appeal directly to our ideational consciousness. Modified nutrition of the brain—Effects.

But this state of absent consciousness is not permanent, since there are lucid intervals when the mind appears to be in perfect activity, and when the process of aggregating and collocating ideas, of decomposing complex ideas into simple ones, and of combining simple ideas into general expressions, is performed to a great extent automatically; and thus many philosophers believe that the same amount of mental and bodily application which is shown in temperate climates can be performed in the tropics—that the same vivid train of thought, the same mental consciousness and reasoning faculties, can be there exercised—in a word, they believe that there exists the same central activity, which, when our attention is fixed upon a certain class of ideas, suggests to our consciousness the same train of thought, in continuous and rapid succession, independently of our will, or without any purposed direction of our will to it, as is met with every day in temperate climates. This condition, when duly considered and examined, it will be admitted, forms an *a priori* argument, which cannot possibly be attained in tropical climates. Lucid intervals.

The foregoing statement exhibits, without a doubt, the reasons why natives of tropical climates do not show the same active development of the intellectual faculties, especially of the reasoning processes, as natives of a temperate climate. Thus, with the former, the combination of suggestive ideas so as to produce important results in a material form, can only with great difficulty be obtained; and since this alone is the great source of improvement in knowledge, it is no wonder that the natives of tropical climates are deficient in the fundamental principle of education, whilst, on the other hand, those of Effects of heat on the native of the tropics.

temperate climates have every facility offered them. The young native inhabitants of the tropics do not undergo any proper mental cultivation; the fixation of their attention to certain objects, exclusively of many others, is not made the constant study of their parents, who do not instruct them to call into their understanding the relation and connection which exists between different ideas, nor how to isolate ideas and recognise their common properties. They do not withdraw their minds from those noxious influences which may occupy their mental activity—from what is sensual and debasing—and thus bring in appropriate ideas or fertile and productive faculties which will direct and invigorate, cultivate, and chasten their youthful consciousness.

Mental fatigue from heat.

Again, in tropical climates, the uninterrupted application of the intellectual or reasoning faculties for a few hours on any particular subject produces great mental fatigue; the automatic or attractive power, after a very short time, becomes incapable, or finds it difficult, to rivet the attention on the class of ideas under consideration; and the thoughts, in consequence, either wander from the subject or do not "develope themselves consecutively in the mind;" and very often the individual complains of severe headache or vertigo. In temperate climates the case is very different; the author, whilst at college in England, requently occupied fourteen out of the twenty-four hours in hard study without any evil result, but since his return to the tropics he finds six hours to be his utmost limit of continuous application without producing severe mental fatigue; and even this period he finds to diminish the longer he remains in the tropics.

Results of high temperature on Jollofs.

In the northern portions of Western intertropical Africa, viz., Senegal and the Gambia, the temperature, as has been demonstrated in the preceding chapter, is at certain seasons extreme, being continuous for several days from 102° to 110°; and the effects of this heat, *per se*, independently of any local condition, have decidedly ulterior influences in the reproduction and development of the inhabitants occupying these regions. The heat has of itself a great influence in increasing

he deposits of black pigmentary matter in the coloured cells of the epidermis or true skin; in consequence of which the Jollof and Mandingo inhabitants of these regions, but especially the former, are of a jet or lamp-black colour; whilst the Sarra Wollies and Footah Foolahs, who years ago migrated into these countries, become darker every generation, and the present inhabitants are two shades darker than the Moors of the interior, from whose stock they are descendants. It is common to characterise a very dark individual as "Jollof black," since the Jollofs, as a nation, present a more perfect black tint in their pigment cells than any other nation, I think, on the globe, at least that I have ever met with, which seems to prove most convincingly that to the temperature, exclusive of any other condition, we have to trace the colour of the skin.

I must state the fact, that the offspring of inhabitants of other parts of the coast, after residing for some time in this region, become as jet black in successive generations as any Jollof, although they themselves present no change, or very little, in the complexion. The converse of this I have noticed to be equally correct; for Jollofs who remain for a long time in other parts of Africa of a more equable and limited temperature, all things being equal, have offspring of a lighter complexion. Jollofs, in whatever favourable condition they may be as regards food, habitation, attention to bodily cleanliness when resident in their own country, retain that colour of their skin for which they are remarkable, and transmit the same to their offspring.

The heat also interferes with the general nutrition and vital operations of the body, either by disturbing the chylopoietic assimilation, or by acting indirectly through the nerve centres; but one thing is certain, that the inhabitants are much more attenuated than in any other parts, and although generally tall, their muscles are ill developed, and they are incapable of severe muscular exertion, however short; their virile powers are quickly exhausted, and fecundity in the females is very limited. The Mandingo, especially, leads a sort of migratory life.

Even amongst some of the lower animals, which are expected

to be very hardy in their habits, such as goats and pigs, virility is very much interrupted. I observed, in many instances, that a goat, which, as a general rule, brings forth two or three kids, if impregnated during the hot weather and exposed to the full effect of the heat for two or three months, gives only one kid; evidently showing that the heat interferes with the full results of fecundation.

Through the heat the eliminating organs of the body are called upon to perform more work, while the formative organs are retarded in their elaboration. The kidneys during the hot weather are much more loaded with solid matter, much lithates and uric acid, showing increased degeneration and destruction of tissues; the sudorific glands increase in activity, and the perspiration contains an increased proportion of chlorides and other salts; whilst, on the other hand, we find a decrease in performance of the functions of respiration, digestion, and sanguinification. The operation of these causes tends to diminish the "span of life;" and the average of three-score years and ten is seldom attained by the inhabitants occupying these regions.

Besides being short lived, the inhabitants in this hot region grow early old; they appear in most cases about ten years older than they really are. A Mandingo or Jollof sixty years of age will have a long white beard, with grey hairs, and will give the appearance of a man of seventy years or more, which is not the case in other parts of the coast; and the natives themselves attribute it to the effects of the heat.

Effects of heat on respiration.

High temperature produces a very marked effect on the respiration of individuals residing in tropical climates in North Western Africa, where the temperature ranges in some parts of the year from 86° to 100°. The air is so rarefied in the afternoon that there exists an evident deficiency of oxygen for breathing purposes; an individual will be actually for hours in great distress, and pant for breath; his respiration becomes quicker, but he feels that he cannot take at a time sufficient air to relieve him; he finds immediate relief if he allows the heated

air to pass through a damp atmosphere before it enters into his lungs, and this he does by keeping his apartment continually wet by sprays or jets of water. Besides the want of a sufficient supply of oxygen in the air, individuals in these climates suffer also from a diminished purification of the blood, through a diminution in the exhalation of carbonic acid; the higher the temperature the less quantity of carbonic acid is exhaled.

It has been shown that the climate of the Gambia, Senegal, and the Casamanza, is the hottest in Western Africa; that the temperature during the hottest month in the shade is sometimes registered at 110°; also that the temperature of Sierra Leone, Liberia, the Gold Coast, and the Bights, are comparatively limited, and that the temperature during the hottest month rarely exceeds 90°. It follows that the inhabitants of the latter places exhale more carbonic acid than those of the former, and it is computed to be a little more than two-thirds. According to Vierordt,* a difference of 10° F., in man, produces a variation of rather more than two cubic inches of carbonic acid hourly exhaled.

I have previously stated that the inhabitants of this hot region are tall and attenuated; that their muscular system is ill developed. This has another effect, in diminishing the quantity of carbonic acid exhaled; for the more robust and muscular an individual is, all things being equal, the more carbonic acid he exhales—the height, weight, and capacity of the chest, &c., having very little to do with it. But these inhabitants, especially the Mandingoes, make up for this decrease by bodily exercise; they are a clever, athletic race, and are continually on the move, and consequently are always thus increasing the amount of carbonic acid exhaled; and when the exercise is moderate, it has been calculated to increase to one-third of the quantity exhaled during rest, which continues for some time after the cessation of the exercise.

The importance of these observations will be noticed, when we consider that the number of respirations per minute is from

* Physiologie des Athmens.

15 to 26, or an average of 20; that at each respiration we take in 1·62 cubic inch of oxygen, and consequently make 28,800 cube respirations per diem, and take in and consume 46,656 cubic inches, or 26 cubic feet, or nearly a cubic yard of oxygen during that time. The great heat lessens this quantity to a very prejudicial degree. At each respiration a healthy individual takes in 20 cubic inches of air, and inspires 400 cubic inches in a minute, or 24,000 in an hour; such expired air contains about 4 per cent. of carbonic acid, and consequently 16 cubic inches per minute, or 960 per hour, and 23,040 in the 24 hours, viz., 3·529 grains of carbon. A diminished excretion of this substance vitiates the blood, and produces a very injurious effect on the system.

Atmospheric tides.

Every meteorologist in tropical climates must observe that there are tides in the atmosphere at different times in the twenty-four hours, occasioned by the presence or absence of the sun. According to Humboldt, the flow tide in the tropics commences at 9 or 9.15 A.M., and at 10 or 10.45 P.M.; and the *ebb* at 4 or 4.15 P.M., and at 4 A.M. This statement is pretty correct in Western Africa, except that the late ebb commences about 3 or 3.15 P.M.; the ebb is produced by the expansion of the atmosphere during the hottest part of the day, and the flow to the pressure of the mass of cold air.

Atmospheric pressure.

The pressure of the atmosphere on a given body is directly as its density, or as its solid parts, to its own reacting interstices. In the mean human body the atmospheric pressure is reckoned at about 15 tons, or a total pressure of 32,400 lbs.; but during the hot weather, or at an elevated spot in the tropics, when the atmosphere is much rarified, the amount is slightly diminished; for every degree of heat the air expands about $\frac{1}{480}$th part.

Effects of trees.

It is unfortunate that in Western Africa the local Government has in a great measure overlooked the beneficial effects that will be produced by taking advantage of the delightful properties of trees, in exhaling a certain quantity of aqueous vapour for the purpose of cooling the atmosphere: a more general

planting of umbrageous trees in the highways of the towns will operate to moderate the effects of atmospheric heat. An effort in this direction has been made by the planting of a large number of trees in the front street at Bathurst, in Government Yard at Sierra Leone, in Salt Pond Road, and Jackson Street at Cape Coast Castle; but there should be a more general one, and under a well-directed plan.

It is now the belief of every scientific man, that the further we descend below the surface of the earth the greater is the temperature; and at 45 or 60 feet the increase becomes very perceptible; or in Europe, between the parallels of 48° and 52°, it forms the stratum of invariable temperature. At the depth of 100 feet the internal heat is equal to 2°·25 F., or 1° of R. of increase; but in intertropical Africa the stratum of invariable temperature is 1 foot below the surface, which cannot be due to solar influence. Since, says Professor A. Taylor:— Internal heat.

"1. The existence of a zone of invariable temperature shows that the power of the sun must be limited to that portion of the earth's crust which is above it.

"2. If the interior heat of the mass of the earth were due to external or solar influence alone, the thermometer should fall just in proportion as we descend below the invariable stratum."

The reverse of this is, however, the fact; and hence, we must believe that below this invariable stratum we are arriving at a source of heat situated in the centre of the globe. Professor Alfred Taylor, after an elaborate investigation of this subject, arrived at the following conclusions:—

1. That the temperature of the surface of our globe, including that of the air, earth, and sea, depends exclusively upon the quantity of heat transmitted to it from the sun, the heat thus received being again lost, partly by radiation into space, and partly by conduction downwards through the superficial strata.

2. That the chief loss takes place undoubtedly by radiation, and that it is by the amount of this last we learn the temperature of the medium (space) in which our globe is floating.

3. That, at a certain depth below the surface of the earth, there is a source of heat which progressively affects the thermometer as we descend.

4. That the interior heat cannot be derived from the sun or from local chemical changes.

5. That it does not directly affect climates or seasons, or successfully influence the temperature of the surface of the earth, the depth of the ocean, or the atmosphere floating above them.

6. That the necessitudes of climates, seasons, and cycles of years are due entirely to solar influences.

7. That the influence, even at a maximum, does not penetrate to a greater depth than the $\frac{1}{400000}$th part of the earth's diameter.

8. That although we have positive evidence of the existence of subterranean heat, we can neither measure its degree, nor, at present, determine its exact rates of increase downwards into the interior.

9. That there is not the slightest evidence to show that the earth is gradually cooling from a high temperature, or that, within the last two thousand years, its temperature has undergone any increase or diminution.

In tropical climates the temperature of perennial springs is some degrees below that of the atmosphere; this is more so in North-Western Africa than the other parts, as the temperature of the water does not increase in the same ratio as that of the air. Below 120 feet of water, however, no variation takes place.

Hot springs.

The origin of hot springs may be accounted for from the increase of heat as we descend beneath the surface of the earth, and, since for every 15 yards there is an increase of one degree in a temperate climate, at 3300 yards the heat will be sufficient to boil water.

According to the estimation of Fourier, if below 180 miles the interior of the globe was incandescent, it would be sufficient to raise the surface about a 10th of a degree; and if it be 100 times hotter than red-hot iron, it would take 200,000

years to raise the surface only one degree. However, at 40 or 50 miles it would take only 2000 years to raise it one degree. The heat of the celestial spaces has been the subject of calculation by him and Swemberg, who regarded it to be 50° Centigrade below zero or the freezing point.

From the equator to the poles the temperature of the sea varies but little. On approaching land the thermometer in sea water falls from 4 to 6 degrees.

Earthquakes—Gold Coast and Sierra Leone.

Western Africa is subject to those subterranean disturbances which are connected with internal heat. In 1855 the colony of Sierra Leone was one evening put to confusion by the shock of an earthquake, which took a direction from east to west. In 1861, 1862, and 1863, Accra, on the Gold Coast, was subject to repeated shocks of earthquakes. In August 1862 a series of shocks were felt; the first was so severe that it destroyed the whole of the stone buildings and fortifications at Christiansborg Castle, Dutch Accra, and James Town; it was felt from below the River Volta to 300 miles along the sea coast, and far into the interior. I was present during this and several other convulsive movements. The noise was very astounding, stunned some of the weak nerved and even strong nerved inhabitants, and deprived some of their senses; it was like the noise of a powerful train passing under a tunnel, or the subterranean peals of thunder of the loudest echoes. Cape Coast suffered also in this subterranean agitation, but to a comparatively limited extent.

There are tangible evidences everywhere that the Gold Coast was the scene of repeated earthquakes and volcanic eruptions in ages long past. Volcanic scoriæ are scattered in the highways and along the sides of the clumps of hills around which Cape Coast is built. I have picked up several of these so-called stones, which corroborated statements put forward by me some years ago in a small pamphlet, entitled "Geological Constitution of Ahanta, Gold Coast," wherein the volcanic origin of those parts was taken into consideration. We shall revert to this subject in another place.

CHAPTER IV.

1. ELEVATION OF THE EARTH ABOVE THE LEVEL OF THE OCEAN.—2. THE GENERAL INCLINATION OF THE SURFACE AND ITS LOCAL EXPOSURE.—3. THE POSITION OF ITS MOUNTAINS RELATIVE TO THE CARDINAL POINTS.

Elevation.

THE elevation of a country or place above the level of the sea is of very great importance in a sanitary point of view; the generally acknowledged maxim—the higher we ascend the more healthy we become—is nowhere to be regarded as of greater practical utility than in the tropics. In Western Africa we find that the poorer classes of inhabitants, who occupy mud-huts and sleep on mats spread on the bare mud floor, present a greater mortality than even those who occupy the same species of huts, but sleep on sofas one or two feet above the ground. The frame houses, raised about two feet above the ground by stone pillars, allowing a current of air to circulate under the flooring, are the most healthy of the houses of this description in the tropics, and their inhabitants present less annual mortality than those who inhabit mud-huts.

Gambia site.

The site of the British colony on the banks of the River Gambia is so low that it is scarcely two feet above the level of the sea; in some places it is below the sea-level; and Bathurst, every year, is subject, at any very high seas, between July and September, to be inundated, as was the case in 1847 and 1851. Lately Col. D'Arcy, the governer, with his superintendent of police, has worked hard to remedy this state of things;

and a barricade has been made to prevent these unpleasant results.

In the immediate neighbourhood of St Mary's, and at Combo, there are extensive plains of offensive and pestilential swamps, which, during the rains and the blowing of the N.W. and S.W. monsoon, add greatly to the unhealthiness of the colony. For the sum of L.7000, says Major Clerk, R.N., this swamp, covering nearly 1000 acres of land, can be most effectually drained; but the exchequer of the colony being in a very impoverished state, there is no hope this recommendation will be carried out. Bacchou, or Cape St Mary's, is situated on a small rising ground facing the sea; it is the most healthy spot around St Mary's, and has been used as an invalid station from Bathurst.

Bacchou, or Cape St Mary's.

M'Carthy's Island.

M'Carthy's Island, another station situated about 250 miles in the interior, is about $5\frac{1}{2}$ miles in length and 1 in breadth. During the rains it forms an extensive plain of muddy swamp, with a pool of water dividing it almost in two, and emptying itself into the river. It presents no high ground, and when there happens to be a severe rainy season, the island is almost flooded with water. There are large ditches and trenches made at various parts of Georgetown to carry away aqueous accumulations, but the number is too small for the requirements of the place. Towards the end, and in the beginning of the rains, these pools are converted into muddy swamps, exhaling a most deadly vapour.

M'Carthy's Island is exposed to whatever influence of wind it might be subject to, whether mephetic or hygienic, towards the S.W., W., N.W., N., and N.E. At the east and south it is imperfectly sheltered by a low range of hills in the mainland, which is nearly 200 feet high. The general inclination is from N.E. to N.W.

The barracks of M'Carthy's, hygienically, should have been built on the range of hills on the mainland, which is known as Fa-to-to hill, situated on the east of the island, on the Nyanney ground. Their elevation is sufficient to moderate the heat,

which is so intense in the hot season among the swamps of the lowland.

The general, as well as local inclination of the colony at Bathurst, including Combo and Bacchou, is towards the swampy banks of the river, and consequently N.E. to N.W. There are no elevated spots around these stations, no mountain or hills, but one flat plain, which is exceedingly swampy during the rains. A few miles from Bathurst, along the river, is the town of Albreda, formerly belonging to the French, but exchanged for Potendie with the British Government. It is built on the declivity of a small range of hills, and forms a more eligible and important station for the principal seat of government than St Mary's or even the Cape. If the summit of the hill be occupied, it will not be very inferior to Cape St Mary's for healthiness, and very far superior to Bathurst or St Mary's; but in a commercial and political point of view it will be superior to any other point on the River Gambia. At present it is the seat of an extensive trade with the natives, but is neither a military nor a colonial station.

Albreda.

Sierra Leone site.

An extensive range of bold lofty mountains, running from W.S.W. towards E., and then shaping itself to the south, forms the peninsula of Sierra Leone. They are, I believe, of a volcanic origin, although many have thought that they must have been produced by a huge process of denudation. The highest of these ranges is Regent Mountain or Sugar-Loaf, about 3000 feet above the level of the sea, and commanding a most extensive view. Uninfluenced by any local peculiarities, it is subject to all the climatorial changes in the weather, and, from its height, receives the breeze in the very same state from whatever position it may proceed. From Sugar-Loaf the mountain runs towards E.S.E. until it becomes partially lost a little way beyond Hastings, or merges into the Waterloo range, the highest peak of which is known as Mount Horton, which terminates abruptly between Kent and York, facing the Atlantic.

Sugar-Loaf.

Another range in front, and to the south and east of the former, commencing from Signal Hill, where it is almost 400

or 500 feet above the level of the sea, ascends gradually through Wilberforce to Leicester, where it abruptly forms itself into a cone, from 1500 to 2000 feet above the level of the sea. From hence the range occupies the front and rear of Gloucester, meeting at a juncture between Kissy and Bathurst, and terminating gradually from Wellington to Allen Town.

Local aspect and declivities.

The general declivity of Sierra Leone is therefore towards the east and south-east, but there are great differences in its local declivities. The whole of the towns and villages of Sierra Leone are either partially or wholly built on elevated spots, but the numerical difference in their healthiness depends, I am of opinion, on their local aspect.

Freetown.

In a sanitary point of view, the spot now occupied by the city of Freetown is the most unhappy that could have been selected for the capital and *entrepôt* of trade. It is covered towards the south and south-east, south-west and west, by high and lofty mountains; its aspect or declivity is towards the north and east, facing the mainland, and exposed but very impartially to the north-west or the ocean. It is built in the plain at the foot of the lesser chain of mountains already described, where it makes an angle between Signal Hill and Kissy Range, and is therefore screened from all breezes arising from south-east to west. At the centre of the town is an abrupt hill, about 400 feet high, possessing a table-land at its summit, which is occupied as a military station. The town around is low, except in front, where there is a gradual ascent from the river to this elevation, which is called "Tower Hill."

Effects of sun's rays.

It is a well-known fact, that by a proper exposure of the soil to the action of the sun a most beneficial result is obtained. "A hill inclined 45° to the south, when the sun is elevated 45°, receives solar rays perpendicularly, whilst upon a plain the same rays strike the soil under an angle of 45°, that is, with one quarter less of force; and a hill inclined 45° to the north will be struck by the solar rays in a horizontal direction, which makes them glide along its surface." Again, local aspect has a most powerful effect in altering the effects of the prevailing

winds in a country; and these two results, viz., the action of the sun on the soil, and the alteration of the effects of the prevailing winds by local aspect or declivity, but principally the latter, must be regarded as the grand keystone to an explanation of the unhealthiness of the city of Freetown in Sierra Leone (and not, as has been most wrongly stated in books, the colony of Sierra Leone).

December solstice.

During the December solstice the sun is about 32° south of Freetown, and its benign influence is consequently lost early in the day, through the interruption of Leicester Mountain and afterwards Sugar-Loaf; that is, towards evening evaporation decreases and condensation begins to take place earlier, through the loss of the direct rays of the sun. We know also that malaria is generated and concentrated on the surface of the earth, or just above it after sunset, when the heated and consequently rarefied air becomes cooled down; any influence, therefore, which deprives a place of the full action of the sun does to a certain extent predispose it to disease. Fortunately, however, at the December solstice there are other climatic influences which moderate the injurious effect that might have been produced.

June solstice.

In the June solstice the sun sets about 15° north of Freetown, but its rise is interrupted by the position of the lesser range of hills, and the town receives the sun's rays only in a slanting direction. Tower Hill interrupts in some measure, secondarily, the due action of the sun in every part of Freetown; its position in the very centre of the town has a direct influence, at whatever position in the compass the sun rises or sets.

Monsoon.

Towards the end of the October or north-east monsoon, namely, at the beginning of April, the wind shifts from N. and N.E. to S.W. and W., but occasionally blowing from E. and N.E. At this time the rain gradually begins to fall; the dried up dead vegetable matter receives moisture and begins to putrefy, and consequently forms the source of unhealthy exhalations. The wind from E. and N.E. blows from the Continent through an extensive track of these unhealthy emanations,—through

swampy Quiah, Timeneh, Bullam, &c.,—striking Sierra Leone between Wellington and Hastings, bifurcates. A part takes the direction in front of the lesser range, passes through Wellington, Kissy, and then Freetown, where it is interrupted in its course by the concavity below Leicester range, and has to mount Wilberforce, or make a detour through the Cape before it gets into the sea. This wind, impregnated with mephitic substances, deposits a larger quantity at Freetown through the interruption which it meets at the concavity, and does not at all relieve the town of the miasmata that is generated from it. The next half of the wind passes between the gulf made by the two ranges of hills over Allen Town, then ascends to Charlotte, Bathurst, Regent Town, and after passing Lumley, is lost in the sea, near the Cape, meeting with the first half, and during its ascent loses a greater portion of its miasmata. But the principal wind at this season (April and May) is generally from S.W. and W., blowing from behind the mountain. I have before stated that at this the commencement of the rains, which is at Sierra Leone in the latter part of April and May, there are most unhealthy emanations from the earth's surface, that the vapour is like steam rising from the ground, and producing great depression; the most sanitary effect of a strong current of wind is to displace this and drive it away from the place where it is being generated. Freetown, by its local aspect and declivities, entirely loses these beneficial results; the high mountains, towering behind and nearly all around it, interrupt the wind in its course, especially the S.W. When due W. it passes over Wilberforce Hill, touches Tower Hill in its course, but scampers over the town below it, and then sweeps through Fowrah Bay. The miasmata, which seeks the lower level, remains in its position, and forms the source of the most concentrated form of febrile affections. The only healthy breeze that blows through the town of Freetown is the N.W. wind, which proceeds direct from the Atlantic, and is uncontaminated by any poisonous vapour.

When all these circumstances are taken into consideration, can there be a doubt in the mind of any one why Freetown (and not Sierra Leone) is so unhealthy at certain periods of the year? why the concentrated action of poisonous air, uninterrupted by any aerial disturbance, should be the cause of a most deadly form of fever? These facts, I am of opinion, are the real source of the unhealthiness, added to which is the neglect of the local Government in effecting proper sanitary works; there are no proper effective drains, and year after year the excessive mortality cries loudly to the legislature and the executive council for reform.

Healthiness of Sierra Leone.

But Sierra Leone is one of the most healthy spots on the whole western coast of Africa. The high and lofty peaks invite, but in vain, the inhabitants of the low, steam-vapoury Freetown, and point out the spot which nature designed them to inhabit. They call upon them to plant villas everywhere on their numerous platforms, and to retire there after their business is over; but all their warnings are in vain. So long as the merchants will not occupy the hills—so long as they will continue to sigh for gold, unregardful of their health—and so long as the local Government will still continue to persist in disregarding that essential element for improving the health of the town, viz., sanitary reform,* so long will the European and native population show a heavy yearly mortality.

Sir Ranald Martin† has given the following summary as to

* In the author's pamphlet on the "Political Economy and Requirements of British Western Africa," whilst recommending the necessity for the formation of a municipal council, the following occurs:—"Tho time is perfectly ripe when Sierra Leone should have a town corporation, since the existence of such a body in a country is a true sign of advance in political matters, and we hope that no narrow-minded prejudice will prevent its immediate establishment. . . . . Sierra Leone, from its rate of mortality and the necessity for a vigilant sanitary police, requires a town council and a medical registrar. It will root out the pernicious causes of the diseases in the colony, will relieve the police-court of a great many of its cases and officers, and consequently will save the colony a fair sum of money. The benefit derived from the summonses, fines, &c., after paying all expenses, should be used entirely for renovating the town, clearing it of filth and dirt," &c.

† Influence of Tropical Climate on European Constitution.

the localities to be selected for forming military camps, cantonments, and stations in tropical climates, which, I think, well deserves the consideration of civilians also :— Localities to choose.

1. When military circumstances do not imperatively forbid it, an elevated and dry soil should always be selected for bivouacs, camps, or cantonments, on undulating ground or the declivity of a hill, the most healthy sites being such as do not, from the natural fall or from the quantity of the soil, retain moisture.

2. Open downs so called are healthy.

3. Such grass lands as have a sufficient fall or inclination are healthy.

4. The elevated banks of rivers that have a sufficient fall either way.

5. Tongues of land, or slender promontories jutting well into the sea.

6. It is said that wherever pure spring water is procurable, there the ground is generally fit for encamping or cantoning troops.

7. When marching, to halt, during wet weather, on ground somewhat elevated and sloping, and sheltered from the wind.

8. In such cases to increase the number of fires, and to keep them up to the starting time.

9. To make frequent halts, selecting places where the water is good, and to take care that the men do not drink cold water when heated by the march.

10. In marshy localities, to encamp on the highest ground procurable.

He has also given the following rules, pointing out the localities to be avoided :— Localities to be avoided.

1. All damp ground to be carefully avoided, and even where the surface may appear parched up and destitute of vegetation, if it be moist underneath, as by previous rains, it may be found charged with the worst exhalations.

2. Half-dried beds of rivers, of canals, tanks, or ditches, and narrow gorges.

3. Marshy grounds, and such as are elevated immediately above marshes, and grounds which are exposed to winds and currents passing over marshes.

4. Ground covered with underwood, or the vicinity of such ground.

5. The low, jungly, or marshy banks of rivers and lakes.

6. The best ground, if long occupied by masses, becomes contaminated; it is, therefore, an established rule to change the ground of encampment frequently.

Horace Wilson had said, that "if British colonies be ever formed in the East, with a chance of preserving the moral and physical energies of the parent country, it is to the vales and mountains of the Indian alps that we must look for their existence." As with the East Indies, so with Africa; and I say that if the Europeans intend to preserve their lives in Western Africa, if the Government is determined to cultivate the healthy growth and vigour of the rising generation, they must lay out and carry into effect extensive plans for properly occupying the mountains of the African alps. In the mountains are the towns of Leicester, Gloslu, Regent, Bathurst, and Charlotte. The local aspect of the three first, together with their position on the summits and vales of the mountains, show that they must be the most healthy places in Sierra Leone, and experience has proved it to be the case.

The river districts, viz., Kissy, Wellington, Hastings, and Waterloo, present the same disadvantages as Freetown, being low, exposed to the most unhealthy and injurious breezes, and sheltered from those that are healthy. The sea district towns, viz., Kent, York, and Bannana Island, are healthy, being exposed to every current of air, and washed by the ocean; the first and last have special advantages, the former being placed on the promontory of Sierra Leone, the latter being an island in the Atlantic.

I have before, in another place, recommended that a sanitarium should be made at the summit of Sugar-Loaf. The experience of Newcastle, Jamaica, has led many to believe

that it will be of great importance to the colony and the coast in general; but when the site is chosen, sanitary rules will require that the buildings should be made to face the Atlantic as much as possible, but not to face Regent's Town. The only difficulty is that of transport; but if the path to the Himalaya can be made available for practical purposes, I do not see why a peak 3000 feet high could not have an easy path made through it. It must be borne in mind that an elevation of 2000 feet above the level of the sea is a good protection against the deadly fevers of tropical climates, and therefore Leicester mountain should also be occupied. Two thousand five hundred feet is a safeguard against yellow fever or black vomit, and the local Government should at once cast off the *vis inertiæ* that at present prevents them from occupying Sugar-Loaf mountain.

Leaving Sierra Leone, we arrive at towns quite exposed to the Atlantic. The most important of these is Monrovia, the capital of the Liberian Republic; its salubrity, through its local declivities, is very questionable, since it "is deprived of the northern sea breeze in its purity by the long sandy beach and brushwood which stretches from Cape Mount to St Paul's River, across which it must pass before reaching the place, and of the westerly winds by a high peak of land intervening between the town and the sea." Monrovia, however, is built on an elevated land. Monrovia site.

Cape Palmas is a flat country, exposed in every direction, except towards the north, to the Atlantic, and consequently enjoys the refreshing breeze uncontaminated when it blows from N.E., E., S., S.W., and W. Its local and general declivity is towards the ocean, and it is without exception the most healthy spot in the republic of Liberia. It is slightly elevated above the sea-level, and is well watered by many magnificent rivulets. Cape Palmas site.

The British and Dutch possessions of the Gold Coast, occupying an extent of more than 350 miles, including the various districts of Apollonia, Axim, Ahanta, Elmina, Cape Coast, Gold Coast.

Anamaboe, Winnebah, Accra, Adangme, and Awoonah, must now be considered. All the districts from Apollonia to Winnebah are built on slight elevations above the level of the sea; the general inclination of the surface, as well as their local aspect, is towards the broad ocean, in the direction from north-east to west-south-west, the north and north-west portions being towards the mainland. Axim contains a Dutch fort, which is built on a rock near the mouth of the River Axim. The country around is low, moist, and thickly wooded; it has no mountains, but at some distance from the town clumps of hills are here and there to be found.

Ahanta.

In Ahanta there are three important towns, viz., Secondee, Bantry, and Dix Cove; they are all built on a slight elevation from the sea, and are surrounded by abrupt clumps of hills. There are no mountains near this part of the Gold Coast, but only small hillocks. "Passing through Chema, as one approaches the Ahanta coast, several objects of scenographic importance arrest his attention: a land jutting far into the sea; a sea-coast covered with blocks of huge basaltic rocks; breakers extending to a considerable distance into the sea, forming, as in Secondee, a natural breakwater; here and there hillocks of no mean size, and so abrupt as to give sufficient evidence of the manner of their origin; and a country well watered by beautiful streams and rivulets. The breakers are principally produced by rocks under the sea, encrusted with several varieties of medrepore corals, stretching in the form of capes a great distance into the sea; in some places outcrops of these rocks, in very low tides, are to be traced about one and a-half mile from land. The most extensive breakers rise in Cape Three Points, which extends almost two and a-half miles; the next at Adjuah, the third at Achowa Point, and the fourth at Mumford."*

Hills at Elmina.

The towns of Elmina, Cape Coast, Anamaboe, and Winnebah, are all built on rising grounds, and surrounded by clumps of hills, which, at the three former places, are just behind the

* Geological Constitution of Ahanta. By the Author. 1862.

town, and at Winnebah, at some distance from it. At Elmina, on one of these hills, Fort St Jago is built. At Cape Coast are five or six prominent hills. On the first and second Fort William and Fort Victoria are built; the next two are known by the names of Corner and Barnes' Hills, or *Kardo*, each of which contains a mud fort, built by Commodore Wilmot of the "Rattlesnake." At Anamaboe there are three unoccupied hills, the highest of which, Mount Blankson, is situated on the north-east portion of the town, behind the little town of Agah, which it overlooks; they all rise from an abrupt base, and are of a conical shape. From Anamaboe to Accra there are a few high hills, not worthy the name of mountains; the most important of these are situated behind Mumford and Mamquadee. "There are no mountains," says Dr Tedlie in his report to Dr Nicoll, "within several miles of Cape Coast, the highest land not being above 200 feet above the level of the sea; nor are these plains of great extent. The country, however, is not without beautiful scenery; clumps of hills are to be seen everywhere, with their corresponding valleys covered with a most luxuriant foliage throughout the year. The whole of the country, as far as the eye can see, is one continued forest until you reach the boundaries of the Winnebah and Accra countries. Here extensive plains, with clumps of trees and bush, are beautifully interspersed. These plains, however, are not without their evil consequences to Europeans, for, during the rains, when the rivulet is filled with water to such an extent as to overflow its original boundaries, it bursts forth and covers the plains, presenting an extensive watery surface for the action of the powerful rays of a vertical sun."

Cape Coast.

Anamaboe.

Mount Blankson.

All these clumps of hills are decidedly of a volcanic origin. I have many a time picked up beautiful black shining metallic-like lava or volcanic scoriæ from most of the hills at Cape Coast, which proves that most of them, if not all, must have been the subject of volcanic upheavals at some distant epoch.

Volcanic origin.

Accra and Adangme are plains which are muddy in some parts and sandy in others. During the rains they are very

Accra and Adangme.

swampy; they are very much exposed to the sea breeze from whatever direction; they are but slightly raised above the level of the sea. The principal towns are James Town, Dutch Accra, Christiansborg, Prampram, and Addah, which are all on the border of the sea. Their general inclination and local aspect are towards the Atlantic, and chiefly between north-east and east-south-east.

Aquapim mountain.

Behind, and in the interior of Accra, is the Aquapim mountain, which is about 1500 feet above the level of the sea, having a declivity from south-west to north-east. The principal station is Akrapoug, where the Basle missionaries have large stone buildings. The climate is very healthy; the air is colder and more invigorating than in the towns along the sea shore. The mountain is covered with an extensive forest, which makes it continually cool. It forms the sanitarium for the European missionaries of the Basle Connexion, who have always, to my knowledge, returned from it after a few weeks' residence quite renovated.

Shai and Crobboe mountains.

Behind the Adangme district are, first, the Shai mountain, which is an abrupt basaltic production, running from south-west to north-east, and whose aspect is in the latter direction. I have been on the summit of this hill, which is composed of huge rocks, entirely displaced and in confused masses everywhere. Next to Shai is Crobboe, which is an abrupt formidable mountain about a mile in length, rising almost perpendicularly from an extensive plain. It presents an open flat surface on its summit, on which two large towns are built. It runs from south-east to north; its local aspect is north-east and east, and it receives the rising sun full and uninterrupted, but the setting sun is received slantingly. It is cool and healthy. Towards the northern aspect the mountain side is covered by thick forest, but to the south-east it is generally bare, being only covered by rank grass. From its abrupt rise on the Crobboe plains, as well as its formidable appearance, an intelligent military officer has designated it "the Gibraltar of Western Africa."

Still further behind the Crobboe hills are the Aquamboo range of mountains; they run from north-east to south-west, and their aspect is towards the east and south. The range, at its north-east extremity, is stopped short by the River Volta, which waters these regions. At this position it rises abruptly above the rest of the range, forming a peak, which receives the name of Mount Pine. I ascended one of these ranges in 1863, situated near the Basle missionary station of Odumasi. Before me there was an extensive plain, dotted here and there with abrupt hills or mountains of various heights. Alongside the Volta, towards the sea shore, the highest of these, Ningo Grand, stands boldly out; it is a conical, abrupt mount of good height, and exposed in every direction to the sea breeze. These several mountains are, without doubt, of a volcanic origin; and the plains, which are covered with sand and marine shells, must have been raised from the depth of the ocean by subterranean disturbances at an early epoch of the world's history. Their summits are healthier than the plains; and the suggestion that Acropong should be made an invalid station, if carried out, will be a step in advance in sanitary matters.

Aquamboo mountain.

Ningo Grand.

Leaving the Gold Coast, we arrive at an extensive narrow tract of sandy land, extending from the River Volta to the Niger, and included under the name of the Bight of Benin. These tracts were of coral formation originally, but they have been covered with sand and alluvial deposits. About fifteen miles from Cape St Paul is Quittah, which was formerly a military station, but which is now abandoned both by the civil and military authorities. The coast all along this bight is low and swampy, especially during the rains; the island of Lagos, which has lately been received as a British colony, forming no exception to the general rule.

Bight of Benin.

Quittah station.

There is but slight elevation above the level of the sea, and the general and local inclinations are towards the Atlantic. No mountains or elevated spots are to be seen, except far into the interior. Between the mainland and the interior there is a lagoon of brackish water. The island of Lagos originally

was of coral formation, but has been increased by the continual deposits of alluvium from the surrounding rivers. It is situated at the confluence of the rivers Ogun, Oshun, and Ossa, which unite to form the Kradu Water, and discharge themselves into the sea over Lagos bar. "The delta formed at the mouth of this lake," says Dr Roe, Army Medical Staff, "had been originally a mud bank. On this has been formed a sandbank, which constitutes the island of Lagos. Its greatest length from east to west is three miles; its greatest breadth from north to south, one mile; but these measurements must not be considered as giving the area of the island, from the great irregularity of its outline. The depth of this deposit of sand varies from six to sixteen feet, and underneath it is always found argillaceous earth, white or grey in colour. Clay is found on the western bank of the lagoon, opposite to the town, of good consistence, and used for making serviceable bricks. They are friable, and do not stand exposure to moisture well, but, as a reason, the clay is not thoroughly puddled, and the bricks are not properly burnt. . . . . In no part of the island is there much elevation above the level of the surrounding lagoon, perhaps the highest does not exceed thirty feet above this; and these elevated portions exist only in two places, and then in an area of only a few square yards. A large part of the island is absolutely below the water level; and two of these tracts, the larger than the others, form swamps, which reach within a short distance of the sea on either side, while branches of the lagoon indent the margin in all directions."* The mainland in the immediate vicinity of Lagos presents no eminence or rising ground worthy of notice, but at Epi and Ikorodu the ground has a decided rise from the bank of the river.

Lagos, Site of.

We come now to the last portion of Western Africa, extending from the River Niger or Cape Formosa, in lat. 4° 5′ N., long. 6° E., to Cape Lopez, in lat. 36′ 10″ S., and long. 8° 40′ E., forming the Bight of Biafra. In this tract there are immense

Bight of Biafra.

* Medico-Topographical Report of the Station of Lagos, West Coast of Africa. Blue Book—Army Medical Department, 1862.

lofty mountains, higher than those seen in any other part of Western Africa. The country along it is of considerable elevation above the level of the sea, the northern portion having an inclination towards the south and south-east; the southern showing an inclination towards the west and south-west. There are no stations along the whole coast line occupied by the English Government, and, consequently, I must be brief in my description. Between the Old Calabar and Camaroon Rivers there are lofty mountains, the highest of which, the Camaroon Peak or Mongo-ma-lobah, rises about 13,760 feet above the level of the sea; the lesser Camaroon Peak is about 5820 feet high. These mountains, towards their summit, possess the vegetation of the temperate zone and a European climate; they are very healthy, and decidedly of a volcanic origin. To Victoria Station, at the foot of the Camaroon Mountains,—an elevated position,—the missionaries at the Camaroon River when ill are invalided; and a short residence there restores them to perfect health. Camaroon Mountains.

Within this bight there are several islands of volcanic origin. The principal is Fernando Po, which is now occupied by the Spanish Government. Fernando Po The island is very much elevated above the level of the sea, presenting various local aspects. It is very mountainous, the ranges running from north to south-west by south; they are entirely of a volcanic origin. It has two lofty peaks, the highest of which, Clarence Peak, is about 10,160 feet above the sea level. Clarence Peak. Of its volcanic origin Dr Daniel writes:—"Basaltic scoriæ, in different stages of decomposition, with aluminous and other shalified conglomerates, alternately blended with and based on the results of igneous action, fully determined the geological features of Fernando Po, and attest its volcanic origin; while the recent explorations of Clarence Peak, in confirmation of the correctness of these views of its physical formation, have satisfactorily proved it to be an extinct crater of considerable magnitude. Throughout the isle the land in general rises somewhat abruptly from the sea, exposing to the eye faces of basaltic and other rocks embedded

in the soft friable masses of scoriæ, the crevices of which are frequently filled up by tufts of plants and by brushwood. In other places, where the declination of the land is of a less precipitous character, it becomes more easy in its descent. Beaches of fine black sand, with huge rounded fragments dislocated from the circumjacent cliffs, are found at their base; the acclivities surmounting which are uniformly concealed by a dense underwood of shrubs and young trees. On the inferior slopes these volcanic vestiges are covered with superficial crusts of dark red clay, mixed with the loam of decayed vegetation, which, being clothed with extensive woods of bombax, palm, red wood, and other trees of gigantic dimensions, present a very imposing and beautiful effect. Like all mountainous regions in equatorial Africa, the upper plateaus and heights are diversified by the mingled links of a varied vegetation, which, partly corresponding with the woody productions of a more temperate clime, and partly with those found on the lower or maritime districts of the island, are of a less exuberant growth, and do not assume the gorgeous richness so peculiar to African landscapes within the tropics. Adjoining the limits of these woods the ground is conjointly strewed by a thick jungle of dwarf bushes and trees, intersprinkled with occasional specimens of the aborescent fern (*Filix aborea*). Beyond this a verdant sward of grass ascends within a short distance from the more lofty peaks, and is selected by game, herds of deer, and wild buffaloes as their pasturage. In the dry months the natives set fire to the long withered stems, in order to drive these animals into their power, and it is possible that from this circumstance the report has originated of the volcanic eruption of flames, said to have been noticed on the summit of the mountain. The distant range of highlands, as they rise from the flat and undulating terraces that constitute the extreme periphery of the island, proportionately increase in altitude, and finally converge into two terminal peaks, joined by a continuous ridge some miles in extent. The highest of them, called Clarence Peak, is almost constantly enveloped in fleecy clouds."

At the first occupation of this island by the Spanish Government the mortality was very high; they occupied the town of Clarence, which is built on a slight elevation along the water side. Experience has taught them that the higher they ascend the more healthy they become, and now they have built sanitariums on the sides of the lofty ranges of hills, viz., at 1000 feet above the level of the sea, which have immensely reduced the rate of mortality in the island. Spanish sanitarium.

Mountains, hills, and elevated spots have a great influence over the climate of a place. 1st, By their general declivity with respect to the course of the sun. 2nd, By their height. 3rd, By the winds they arrest and those they do not interrupt. Influence of mountains, hills, and elevated spots on climate.

Dr Pickford gives the following summary as their results:—

1. Countries lying to windward and westward of extensive mountain chains are warmer than those to leeward or to eastward.

2. The atmosphere of elevated localities is colder, thinner, more transparent, drier, purer, more bracing, more elastic, more exhilarating, and more ozoniferous than that of the vale or plain below.

3. As a rule malaria is rarely met with on hills and elevated situations, unless generated by stagnant pools on the tableland or plateaus of the hills themselves, its great specific gravity precluding its ascent to high grounds.

4. Elevated localities are exempt from typhus and remitting fevers, and are in every respect more healthy than the valley or plain.

5. The atmosphere of mountains and high situations, says Aristotle, is much more agitated than that of low ground.

6. More rain falls among the mountains than in the plain.

7. The reading of the barometer is not so high on hills and mountains as in the plains below.

8. Mountain travelling, in consequence of the purity, elasticity, and ozoniferous qualities of the air, is highly conducive to health.

9. The effect on the pulse and respiration of mountain travelling is to accelerate them.

According to M. de Saussiere the air of low plains is less salubrious, because it is loaded with heavy exhalations, sustained by its density; on the other hand, that of mountains more than 500 or 600 toises (3196·85 or 3836·22 feet) above sea level is vitiated by other exhalations, which, possibly lighter than common air, do not the less impair its salubrity.

CHAPTER V.

1. THE NEIGHBOURHOOD OF GREAT SEAS AND THEIR RELATIVE POSITIONS.—2. POSITION IN RESPECT TO LARGE RIVERS OR LAKES.—3. POSITION IN RESPECT TO FOREST, VALLEY, AND LOW LYING LAND.

THE neighbourhood of the sea has a great influence in moderating the temperature of a country or town. It follows with great slowness alteration in the temperature of the air, and in consequence moderates any excess of temperature that is likely to be occasioned; thus, the nearer a town is to the sea, the less will the extremes of heat and cold be found: the further inland a country be, *cæteres paribus,* the more the extremes are observed. Influence of neighbouring sea.

The sea-board towns of intertropical countries are always cooler than the interior of the continent. Thus, during the Ashantee expedition of 1863-64, the encampment at the banks of the River Prah, about 180 miles from the sea coast, was at an average ten degrees hotter than Cape Coast; this is due to the cooling influence of the sea water over the wind as it passes over its surface. The atmosphere is generally more invigorating and healthier than in the interior, through the development of a larger quantity of ozone in the atmosphere. Temperature.

By the evaporation that is constantly going on along the sea shore, places thus situated are plentifully supplied with atmospheric electricity generated through that action (Pouillet). Electricity.

In tropical countries the banks of rivers are generally very

Banks of rivers.

unhealthy; the emanation from the surface of the river does not consist of aqueous vapour only, but also of deleterious gases, such as sulphuretted and carburetted hydrogen, &c., besides which the muddy swamp that is occasioned gives off very poisonous vapours. The mean daily temperature of the water of the river sometimes exceeds the minimum temperature of the country or town around, in which case the water exhales mephitic atmospheric gases, the result of putrefaction of the vegetable and animal matter which it receives in its course, and which is held in solution by them; and this water, when drunk by individuals predisposed to bowel complaints, at once produces dysentery and diarrhœa. These diseases continue in amount and severity in direct ratio with the increase of temperature, and decrease as the heavy rain increases the bulk of the water, and diminishes its temperature.

Surface of river water.

Through the evaporations and exhalations that are constantly going on from the surface of water, especially in tropical climates, the banks and surface of the river and neighbouring country are always covered with mists, fogs, or haze, which is principally the case when there exists a great difference between the temperature of the atmosphere and that of the water. This haze or mist is observed generally in the morning before the heat of the sun dispels it. Thus, during the harmattan months, in the upper portion of the River Gambia, when the temperature of the water is very low, ranging from 50° to 56° in early morning, the surface of the river and the adjacent lands are generally covered with thick mist.

Results of ebbing tide on river banks.

The ebbing of tidal rivers by the ocean tide, such as those met with in every part of Western Africa, leaving muddy banks with dead vegetable and animal putrescent matter exposed to the direct rays of solar heat and the influence of the temperature, twice during the twenty-four hours, are productive of deadly emanations which might produce fever, diarrhœa, and dysentery.

Lakes and lagoons.

When lakes and lagoons are well supplied with water, and their banks are high and steep, they give out no pestilential

vapour, but when their banks are low, and the water is subject to be diminished, their banks become exposed to the direct rays of the sun, and the vegetable and animal remains become decomposed, and form the source of malarious fevers. The lagoons in the Bight of Biafra are the source of the most deadly emanations: the banks are open, flat, and covered with rank vegetation, and here and there pools of water. During the dry season there remains an extensive tract of slimy mud, which sends forth pestilential vapours.

But lagoons, lakes, and swamps, when surrounded by large umbrageous trees, by forest trees and green vegetation, are not unhealthy, nature having provided the leaves of these plants with the property of decomposing and destroying the malarious poison by the oxygen which they give out, forming ozone by combination with the oxygen of the air, and of absorbing certain noxious emanations; but when marshy land, covered with forest and underwood, is deprived of solar light and heat, of a free circulation of the air, and the woods are close and impenetrable to atmospheric influence, it becomes very unhealthy.

Forests and woods.

Countries that are well supplied with forests or woods are very much cooler than those which are open and cultivated; the reasons are that they shelter the surface of the earth from the direct rays of the sun, and consequently prevent radiation from it (the process by which the atmosphere is heated)—that the leaves give out a large quantity of watery vapour—that they absorb solar heat, and increase the amount of cooling superficial or radiating surface.

During the day, whilst there is sunshine, plants absorb and decompose carbonic acid from the atmosphere, assimilating its carbon and giving out its oxygen to the air: during the night, or in the shade, they absorb oxygen and give out carbonic acid. But malaria is most active and deadly from sunset to sunrise, at the very time when plants absorb oxygen and give off carbonic acid. Marsh miasma "is arrested, and probably neutralised, decomposed, absorbed or respired, by large thick

leafy trees, by dense groves and forests, by masses of foliage and by evergreen shrubs;" and Pliny was correct in his opinion that "groves and trees absorb and destroy mephitic vapours."*

According to Haviland, a forest, intervening between a pestilential marsh and a city, often affords a protection to the inhabitants, and perchance the pestiferous air gets decomposed into innocuous gases during its enlargement among the trees. Sullivan, in his "Visit to Ceylon," corroborates this fact. He remarked that the vicinity of tanks and lagoons of the most fœtid and agueish character was perfectly healthy. They were covered in abundance with various kinds of aquatic plants, including the lotus, of almost Victoria Regia magnificence, which, by a kind Providence, are made "to serve not only as filterers and purifiers of the water itself, but even as consumers of a considerable portion of the noxious exhalations that would otherwise poison the neighbourhood."

Valleys.

The atmosphere of valleys is generally charged with moisture. It contains very little ozone; it is chilly in the morning before the rise of the sun. "During the forenoon, mid-day, and afternoon, the temperature has attained its maximum, and is succeeded by the cold mist and fogs of evening. Mountain chains influence the temperature of the valleys to a very considerable extent. Valleys and plains on the north side of lofty mountains, being deprived of the warming and cheering rays of the sun, are cold and gloomy, and their vegetation is retarded in a proportionate degree."

Mists and fogs—origin.

The morning mists are generally dispelled by the morning sun. These are caused by radiation of heat in calm nights and the cooling of the earth's surface or surface air below the air above; their origin is from the vapour which arises from the earth's surface and from water. Fogs have the same origin, their immediate causation being the admixture of airs of different temperatures. The temperature of the water at night is hotter than that of the superincumbent air, which, "becoming warmed by the water, rises surcharged with moisture, which

* *Op. cit.* vol. i. p. 167.

it precipitates in the form of fog upon coming in contact with the cooler air above."

The fogs generally observed on the tops of Leicester mountain and Sugar-Loaf, or on the top of any mountain, are caused by their sides and summits being cooler than the prevailing wind, condensing the vapour which they hold in solution, while molecules of water form themselves into fogs. According to M. de Saussiere, mists and fogs consist of minute vesicles or hollow spheres of water filled with air, capable of mutual repulsion. Being very rapid in their movements, they chase, repel, and fly to each other in the most grotesque and amusing styles; they are supported and formed in the air by the agency of electricity, derived from the upper strata of the atmosphere.

Having in the foregoing cursorily treated on the advantages and disadvantages of places situated in the neighbourhood of great seas, of large rivers, lakes or lagoons, of forests, and in valleys and low lying land, I shall now briefly describe the relative positions of the different colonies and principal places on the West Coast of Africa with respect to those conditions, and how they either destroy or enhance health.

Position in respect to seas and river and forest.

Gambia.

St Mary's, the capital of the Gambia colony, is situated at the mouth of the River Gambia, on the right bank, and being placed at a concavity of the river, receives a large quantity of the debris and other putrefying matter brought down by the river. It is far below the water level, and is bordered on the north and west by an extensive muddy swamp, which at the commencement of the rains gives out a most deadly vapour. Governor Colonel D'Arcy, in a "Report to the Legislative Council on Dikes and Drains," remarked that the Island of St Mary's was considerably below the level of the sea in some parts,—"For on observing the wells during the dry season, the water is ten or twelve feet below the surface of the earth; whereas during the rains the surface of the water in the wells of the military hospital, one of the highest parts of the island, is scarcely a foot from the level of the ground. This proves that the whole of the race-course and Half Die must be con-

siderably below the level of the sea." "Observing this peculiarity, I was induced early in 1860 to commence the sea-wall round Half Die."

At Government House and burial-ground the sea is encroaching, so that the very existence of the island is precarious. "Let there be a combination of elements," says Colonel D'Arcy, "in a sea breeze, during the month of August, blowing strong when the waumies happen to be in the ascendancy, preventing thereby the ebb-tide from acting freely, and nothing could save the island from being covered with six feet of water, to the great destruction of life and property." He strongly recommended the formation of drains, the building of ramparts against the encroachment of the sea and river, the filling up of marsh and low lands—all which are measures necessary for the sanitary condition of the colony.

The Cape is opposite the sea, and enjoys all the good influence which the neighbourhood of such an element is like to produce.

M'Carthy's Island is a mass of muddy swamp during the rains, and very low, so that in a heavy season the water inundates a large portion of the island. It is entirely surrounded by the river, whose muddy banks, from October to July, through the ebbing-tide, are exposed twice in the twenty-four hours to the action of the sun. During the dry season the alluvial earth is dry and caked; a few large trees are to be seen here and there, but the island is generally bare at this time.

There are no forests near St Mary's, or trees, with the exception of a few mangroves in the swamps; but the early inhabitants were conscious of the benefits to be derived by planting rows of trees in the town, and thus the front streets, and some of the back streets also, are decorated with rows of evergreen trees, which not only give a pleasing aspect to the town, but also produce a most beneficial sanitary result, as we have already seen.

Sierra Leone. Freetown, the capital of Sierra Leone, and all the towns in the river district, are built on the sides of the Sierra Leone

river. The river is, in general, bordered with moderately high cliffs, so that at ebb-tide there are little or no mud banks exposed in those places. But the river forms undulations and bays at different places, and during ebb-tide leaves there extensive tracts of muddy swamp, which act most prejudicially upon the health of the colony. At Freetown, Congotown Bay, Crew Bay, and Granville Bay, form conjointly one of the most pernicious sources of the endemic fevers so destructive at certain seasons in the colony. The Crew Bay swampy tract is in the heart of Freetown ; it is twice every day exposed to atmospheric influence, and gives a most sickening odour. The Grammar School building overlooks this deadly bay ; and can it be a wonder, then, that no European can occupy that spacious building without in a few months, yea weeks, falling into the most severe form of intertropical fever ? Is it a wonder that when yellow fever was prevailing in the town, its principal and his consort fell an easy prey to its deadly paw, and both of them were carried in the same day to a distant graveyard ? Is it a wonder that a successor, who was sent from England to take his place, after a few weeks' residence was invalided, after a most distracting attack of fever ? Is it a wonder, I say, that the present principal, who is a native of the colony, found, after some years of labour, that he was dying by inches, and that his life was most uncertain so long as he remained there, and that he consequently tendered his resignation, which was not accepted ? And need I say, is it a wonder that the building, being formerly a Government House, was sold, after the death of several governors and government officers ? Amongst the former Jeremy was one. And yet is it not paradoxical, that the local Government has not done the least thing towards counteracting this noxious Pontine marsh ? Year after year its deadly effluvia conveys many a valuable life to " the long home," and yet the local Government " dines and sups" by its side without ever thinking it worth their consideration to do something towards neutralising its effects.

Congotown Bay and Granville Bay are but minor swamps

when compared with Crew Bay, but they help, by their emanations, to fill the air of Freetown with miasmatic poison.

Freetown, as well as all the towns in the river district, is situated at the foot of the mountains, with elevated spots at different parts of the town. The most swampy and low portions of Freetown are behind Crew Town, known as Portuguese Town; this is always found covered with mist and fog, especially at the beginning of the rainy season, and is in all respects amongst the most unhealthy portions of Freetown, as the rate of mortality is greater there than from any other part. It is a low lying land, and consequently subject to those disadvantages already described.

The towns in the mountain districts are in the neighbourhood of small, clear fresh-water rivulets, having gravelly bottoms; they rise from the valley made between the range of hills on either side. The climate is cool and refreshing, and there is a constant draught of strong wind. The banks of the rivulets are generally healthy, having no muddy swamp, except at some isolated spots during the rainy season. Kent, York, and Bannana are exposed to the temperate influence of the Atlantic, being situated in its immediate neighbourhood, and receiving the breeze in every direction.

All the towns in Sierra Leone are plentifully supplied with evergreen verdure. The habit of occupying detached buildings, having a piece of land surrounding each habitation, where plants in all the bloom of tropical luxuriance are everywhere to be found, is carried to such an extent, that it is picturesque to stand on one of the mountains and take a bird's eye view of the town;* but the local Government has not yet organised

* The houses are placed on either side of the streets, detached, many of which have beautiful promenades and flower-gardens around them. This reminds me of that portion in Tacitus, where he says, describing the habitations of the German's of his day, "*Ne patiunter quidem*, inter se junctas sedes. Colunt discreti ac diversi, ut fons, ut campus, ut nemus placuit. Viscos locant, non in nostrum morem connexis et cohærentibus ædificiis: suam quesque domum spatio circumdat."—TACITUS—*De situ, moribus, et populis Germaniæ.* They do not even suffer houses to be built in contact. They occupy detached and remote habitations, as the fountain, the plain, or the

means by which trees can be planted in regular rows in the streets of Freetown. Such a plan would tend to decrease the unhealthiness of the town. It has been proved without a doubt, that since the streets were covered with the Bahama grass, the colony has greatly improved in health. With the exception of York, there are no large forests in the immediate neighbourhood of any of the towns, but they are surrounded by low woods and high grass. Sherbro Island is low, swampy, and unhealthy, and presents almost the same peculiarity as M'Carthy's Island.

Monrovia, the capital of the Liberian Republic, is built on the bank of the Mesurado River on a high ground; it is also exposed to the sea. Local influences tell very much against its healthiness. Cape Palmas is situated in the neighbourhood of the Atlantic. In its interior it is well watered by several small streams; it has no large forests behind it, and its healthiness is unquestionable.

The Gold Coast stations are in the immediate neighbourhood of the Atlantic. They are but scantily watered by large rivers; there are only five within a coast line of nearly 300 miles, viz., the Assenee, Aucobra, Boosum Prah, Iyensu, and the Volta. There are no stations built in the immediate vicinity of any of these rivers, with the exception of Chema, near Boosum Prah, and Winnebah, near Iyensu, but they are placed at some distance from the mouth or banks of the rivers. The towns on the Gold Coast are surrounded principally by thick bush of underwood, and in many places by large forests. The only unhealthy water collections are the salt ponds, which are always found outside the towns. There is one at Cape Coast, another at Anamaboe, and several at Accra. They are small lagoons which, during the drying process, give out very offensive and sickly odours, which, their position being towards the south-west, are consequently ever drifted towards the towns.

Cape Coast is quite in advance of Sierra Leone in one

grove may attract them. They plan their villages, not after our own fashion, in rows of adjoining houses; on the contrary, every one has a piece of land surrounding his habitation.—(*The Author's work on the Medical Topography of the West Coast of Africa.*)

sanitary particular: the old European residences have large umbrageous trees planted on either side of the streets, cooling the air, and making an agreeable shade against the noon-day sun. They have squares with shady trees in every direction, which have lately been put into perfect repair by the great sanitary governor, Colonel Couran. This is a step in advance which the sister colony should, without delay, imitate. Several trees should be planted by the sides of these salt-water lakes nearest to the towns, which will tend to neutralise the action of the poison emanating from their banks.

Malaria has an attraction for or adherence to lofty umbrageous trees. Dr Ferguson writes :—"At Paramaribo, the capital of Surinam, the trade wind, which regularly ventilates the town and renders it habitable, *blows over a considerable tract of swamp* at a short distance, but which, fortunately for the inhabitants, is *thickly covered* with umbrageous forests. Experience, besides, has shown that there, as in all other new lands, *the cutting down of those trees in the swamps has ever been a fatal operation* in itself, and in all probability would be *productive of pestilence* to the town." This should always be borne in mind by heads of colonies, and they cannot plant too many trees in the various towns. From the same cause, the inhabitants near the *Dismal Swamp* of America, occupying a tract of nearly 150,000 acres, on the borders of Virginia and North Carolina, very seldom suffer from ague, whilst North and South Carolina and Virginia suffer dreadfully from it. The Bights of Biafra and Benin are well watered with many rivers. The Ogun, Niger, Bonny, Calabar, Cameroon, &c., are to be found here; but we have more to do with stations at Biafra, which are situated on a narrow tract of land between the lagoon and the Atlantic. They are much exposed to the influence of the Atlantic; and although Lagos is a few miles inland, it still is near enough to receive its benefit. The banks of the lagoon are low and muddy, and covered with rank vegetation near the land. At the commencement of the rains, the extensive dried up banks are covered with small pools of

stagnant water, which give out putrid exhalations. It is the great source of the unhealthiness of this part of the coast, and the only remedy would be to cover these banks with large trees.

That fens, bogs, lagoons, and such accumulations are the source of disease, the immortal Shakspeare has even told us. Thus—

> *Caliban.* As wicked *dew* as e'er my mother brush'd
> With raven's feather from *unwholesome fen*
> Drop on you both.
>
> TEMPEST, *Act* i. *Scene* 2.

> *Caliban.* All the *infections* that the *sun sucks up*
> From *bogs, fens, flats,* on Prosper fall, and make him
> By inch-meal a disease!
>
> TEMPEST, *Act* ii. *Scene* 2.

> *Coriolanus.* Though I go alone
> Like to a lonely dragon, that his *fen*
> Makes fear'd, and talk'd of more than seen.
>
> CORIOLANUS, *Act* iv. *Scene* 1.

But we find that the natives have instinctively protected themselves from the results of these deadly emanations from the banks, by surrounding their towns with large lofty cocoa-nut trees, which are densely packed together. This has assisted a great deal in putting down the malaria evolved, and the inhabitants are comparatively healthy. Lagos, as has been described, is situated at the confluence of these rivers, and in some parts is below water-level. There are, unfortunately, not many large trees in the town, and it is not surrounded, as in the other towns, by lofty cocoa-nut trees. Fernando Po has been sufficiently described in the last chapter as to its position in the centre of the Atlantic.

CHAPTER VI.

1. THE GEOLOGICAL NATURE OF THE SOIL.—2. THE DEGREE OF CULTIVATION AND OF POPULATION AT WHICH A COUNTRY HAS ARRIVED.—3. THE DEGREE OF DRAINAGE AND SEWERAGE.

Nature of the soil in relation to certain pathological conditions of man.

THE geological nature of the soil bears very important relations to the sanitary condition of a country,—its configuration and geological characters having a close connection, within a certain limit, with certain pathological conditions of man.

Clayey soils.

The compact nature of *clayey soils* prevents it from admitting both heat and air. It permits the superficial retention water and moisture of every kind. "It generates, how partially soever, those marshy or undrained spots, or wet woods, or moist meadows, which are the sources of malaria, and, consequently, of the various diseases confounded with the vague term unhealthiness." The atmosphere on clayey soils is generally more cool than on other soils, because during the heating process they give out a large quantity of the contained water in the form of vapour, which acts beneficially on the heated air; the air is, however, very damp and foggy, and its effect on the system is very relaxing. The inhabitants of such soils are most subject to colds, coughs, and rheumatism. Clayey soils absorb about ten or twenty times more water than sandy soils, and twenty or thirty times less than surface soils. Clay soils absorb heat less than sandy soils, and cool

down more rapidly also; they allow less quantity of air to pass through them.

Gravelly soils are, when dry, very healthy; they are easily permeated by air, water, and light, and quickly get dry; they are easily drained, and prevent the accumulation of vegetable putrescent matter. Gravelly soils.

Ferruginous soils absorb heat rapidly, and give it out also rapidly. Sir Ranald Martin considers them most unhealthy and deadly. From *a priori* reason I consider that this is not the case, but I shall say more on the subject when we come to consider the ferruginous soils of Western Africa. Ferruginous soils.

Sandy soils in the tropics absorb heat greatly, and are very slow in its radiation in many cases. The heat during the day is very great, and the radiation being slow, at night it is very oppressive, unless other climatic circumstances lessen it: these conditions may be modified by covering these soils with green vegetation. Sandy soils.

Sand absorbs very little water; it passes very rapidly through it, and, *cæteres paribus*, it is generally healthy; but sometimes it contains organic decomposing matter, or the sand is the superficial covering of a clay mould, in which cases sandy soils may become very unhealthy; in which latter condition, the air is generally moistened by the evaporation from the clayey subsoil.

Chalky soils are very healthy, especially when not mixed with marl; they are easily permeable to light and water, the latter of which they readily absorb, and slowly return it to the atmosphere; the air is generally dry and bracing. Chalky soils.

The colour of the soil, also, has some important effect. Dark soils absorb and radiate heat more powerfully than light-coloured soils; but the latter reflect light more, and are hotter from the rays of the sun being also reflected. Dark and light-coloured soils.

Dr Parkes has given the following "General Observations on the Healthiness of Soils:"—* Parkes' observations on the healthiness of soils.

1. *The Granitic, Metamorphic, and Trap Rocks.*—Sites on these formations are usually healthy; the slope is great;

* Dr Parkes' "Practical Hygiene," p. 256.

water runs off readily; the air is comparatively dry; vegetation is not excessive; marshes and malaria are comparatively unfrequent, and few impurities pass into the drinking water. . . . Such regions are often elevated, strong currents of air are more frequent, and the particles derived from the dried stools are carried away.

When these rocks have been weathered and disintegrated, and when they often yield a red or dark-coloured soil, they are supposed to be unhealthy. Such soil is certainly absorbent of water.

2. *The Clay Slate.*—These rocks precisely resemble the granite and granitoid formations in their effect on health. They have usually much slope; are very permeable; vegetation is scanty, and nothing is added to air or drinking water.

They are consequently healthy; water, however, is often scarce, and, as in the granite districts, there are swollen brooks during rain, and dry water courses at other times swelling rapidly after rains.

3. *The Limestone and Magnesian Limestone Rocks.*—These so far resemble the former that there is a good deal of slope and rapid passing off of water. Marshes, however, are more common, and may exist at great heights. In that case, the marsh is probably fed with water from some of the larger cavities, which, in the course of ages, become hollowed out in the limestone rocks by the carbonic acid of the rain, and form reservoirs of water.

The drinking water is hard, sparkling, and clear. Goitre is more common, and, it is said, renal calculus. Of the various kinds of limestone, the oolite is the best, and magnesian is the worst; and it is desirable not to put stations on magnesian limestone if it can be avoided.

4. *The Chalk.*—The chalk, when mixed with clay and permeable, forms a very healthy soil. The air is pure, and the water, though charged with carbonate of lime, is clear, sparkling, and pleasant. Goitre is not nearly so common, nor apparently calculus, as in the limestone districts.

If the chalk be marly, it becomes impermeable, and is then often damp and cold. The lower parts of the chalk, which are underlaid by gault clay, and which also receive the drainage of the parts above, are often very malarious.

5. *The Sandstones.*—The permeable sandstones are often very healthy; both soils and air are dry; the drinking water is, however, sometimes impure. If the sand be mixed with much clay, or if clay underlies a shallow sand rock, the site is sometimes damp. In choosing such a site, the water should be always carefully examined.

The hard millstone grit formations are very healthy, and their conditions resemble those of granite.

6. *Gravels* of any depth are always healthy, except when they are much below the general surface, and water rises through them. Gravel hillocks are the healthiest of all sites; and the water, which often flows out in springs near the base, being held up by underlying clay, is very pure.

7. *Sands.*—There are both healthy and unhealthy sands. The healthy are the pure sands, which contain no organic matter, and are of considerable depth. The air is pure, and so is often the drinking water. Sometimes the drinking water contains enough iron to become hard, and even chalybeate. The unhealthy sands are those which are composed of silicious particles (and some iron), held together by a vegetable sediment. It is nearly impermeable to water, but water dissolves gradually the vegetable matter, and acquires a brownish yellow colour, and, if it comes from six feet in depth, has a marshy odour. It is most unwholesome, and causes intermittent and visceral engorgements. Chemical and microscopic analyses will detect this condition.

In other cases sand is unhealthy, from underlying clay or laterite near the surface, or from being so placed that water rises through its permeable soil from higher levels. Water may thus be formed within three or four feet of the surface; and in this case the sand is unhealthy, and often malarious. Impurities are retained in it, and effluvia traverse it. Merely digging

for water in the wet season will cause the discovery of these conditions.

In a third class of cases the soils are unhealthy because they contain soluble mineral matter. Many sands contain much carbonate of magnesia and lime salts, as well as salts of the alkalies. The drinking water may thus contain a large quantity of carbonate of soda, and even lime and magnesia salts and iron.

8. *Clay, Dense Marls, and Alluvial Soils generally.*—These are always to be regarded with suspicion. Water neither runs off nor runs through; the air is moist; marshes are common; the composition of the water varies, but it is often impure with lime and soda soils. In alluvial soils there are often alternations of thin strata of sand and sandy impermeable clay. Much vegetable matter is often mixed with this, and air and water are both impure. If such spots must be chosen (for a station), thorough subsoil draining, careful purification of water, and elevation of the houses above the soil, are the measures which must be adopted.

The deltas of great rivers present these alluvial characters in the highest degree, and should not be chosen for sites. If they must be taken, only the most thorough drainage can make them healthy.

9. *Cultivated Soils.*—Well cultivated soils are often healthy, nor at present is it known that the use of manure in any form has been hurtful. Irrigated lands, and especially rice fields, which give not only a great surface for evaporation, but also send up organic matter into the air, are hurtful. Where a country is densely populated, and where agricultural pursuits are carried on extensively and to a high degree, the health of the country must of necessity be greatly improved; malaria is prevented from being generated, and the death rate is much diminished. But when a land is first cleared and the soil broken up for cultivation, the exposed land might be the source of malaria for some time; it is always better that it should be done in the heat of the day.

Cultivation in Western Africa.

In Western Africa the cultivation consists only in exposing a small portion of the surface mould just sufficient to cover the seeds, without applying the least scientific measures towards the improvement of them. Their mode of cultivation answers remarkably to the description given of a Hindu field, in the highest state of cultivation, by Mill,—"Everything which savours of ingenuity, even the most natural results of common observation and good sense, are foreign to the agriculture of the" people of Western Africa. "Their ideas of improvement are very limited; they scarcely extend beyond the introduction of irrigation into land which was formerly cultivated dry. Each small proprietor is content to follow the customs of his forefathers; the same rude implements of husbandry, the same inferior race of cattle, and the same practices, are still in operation, which have existed unchanged for centuries. As to any new experiments of general measuring, drainage, differences in the rotation of crops, introducing new grain or vegetables, or new sorts of those already known, any attention to their breed of cattle, any adoption of a better and more combined system by which a smaller number of people could raise the same, or a larger proportion of produce—all these are out of the question."

It is a great pity to find that the Colonial Government still neglects to promote agriculture, and to assist in developing the natural resources of the country, although this was pointed out in the Parliamentary Committee of 1842. This neglect is a great drawback to the prosperity of the various colonies. The European merchants seek quick returns and large profits, and consequently do not give the necessary encouragement and direction to profitable industry. How truly Mr Attarra has said, "It is truly surprising that in a colony like [Sierra Leone] agriculture is considered a thing of little importance. Had education been warmly taken up as the invaluable birthright of the African, he would have viewed the matter with the right eye, and seen that far from being a low employment, agriculture furnishes the most delightful occupation for such a creature as man."

In 1842 the Parliamentary Committee urged upon the Colonial Government the necessity of introducing cotton as an article of trade, and Sir P. F. Buxton did the same some years ago; "but the African cotton brought to the English market was through the exertions of a private friend of Africa, who sent out a small sum and a few cleaning machines to a native teacher in Africa." The first consignment was in 1852, which was small, but this rapidly increased, until in the eighth year it reached to 4000 cwts.

Mr Rosenbush has remarked, that the greatest requirement of the colony is agriculture, and he recommends the establishment of a model farm by convict labour; and the Rev. Henry Venn* says,—"A model farm, to be of real service, should also be a botanical garden for ascertaining and cultivating the best specimens of native produce, and for receiving from the Royal Botanical Gardens at Kew specimens of tropical plants which might be introduced into Western Africa." The Colonial Government has never attempted to develope the natural resources of Africa, although the natives are in that stage of civilisation in which such an attempt would produce a very profitable result. The Government, to make their efforts productive of good, should establish model farms, should give prizes to successful producers of agricultural produce, should form public warehouses where small farmers might store their goods for shipment, and should give as much as possible encouragement and facilities for shipment.

Drainage and sewerage in towns and cities.

There is nothing so necessary for the healthy growth of a community as the drainage and sewerage of the towns they inhabit, and the inefficient mode in which this is done in Western Africa shows that the general population or their superiors have set a limit to their own existence. Yes. "The air we breathe, loaded with carbonaceous matter, sulphurous and sulphuric acid, sulphate of ammonia, and sulphuretted hydrogen, is deprived, by the absence of vegetation, of the revivifying principle, oxygen, and is hence less fitted for the

* Notices of the British Colonies on the West Coast of Africa, p. 32.

necessary changes of the blood effected during respiration. The earth which we tread under our feet, loaded with the ashes of our forefathers, and rich with the remains of animal and vegetable matter of ages long gone by, saturated with the putrefying contents of cesspools and leaking sewers of our own day, emits, at certain seasons of the year, the poisonous emanations which generate typhus, diarrhœa, dysentery, and cholera; whilst the waters of our principal tidal rivers, converted into open common sewers, teem with pestiferous exhalations charged with the germ of disease or the messenger of death. If under these favourable conditions a pestilential epidemic invade our shores, it finds us an unprepared and easy prey."

This should be an important subject with the Governor-General of the Coast. An officer of public health should be appointed in the various colonies in the Coast Government, and ample means afforded him for the efficient performance of the duties which would devolve upon him. He should be made plainly and distinctly to know that his duties are—To examine and watch over the health of the population at large; to see that the water is pure and plentifully supplied; to ascertain that every public building and the dwelling-houses of the poor are properly ventilated; to prevent the committing of nuisances in the streets and lanes of towns and villages, or in their immediate neighbourhood, the burial of the dead in houses, and all noxious and unwholesome trade from being carried on within a given distance from the towns and dwelling-houses; to establish public slaughtering-houses and burial-grounds; to make strict sanitary inspection of all trading vessels; and especially to "lay down and carry out an effectual, efficient, complete, and common-sense plan of drainage and sewerage for every town and city." Officer of public health

The sewage of towns and cities consists of the solid and fluid excreta of men and animals, which, if not continually removed from the dwelling-houses, or if inefficiently removed, Composition of sewage.

forms one of the most prolific sources of disease. Taken at an average of all ages, and the mean throughout the whole year, man passes daily about $2\frac{1}{2}$ ounces of fæcal, and 40 ounces of urinary matter; or a town containing a population of 1000 people excrete in one year 25 tons of fæcal or solid matter, and 91,250 gallons of urine.

In many of the rural districts of Western Africa, and in many small towns, the sewage matter is deposited in the fields, and by the action of the sea, the air, and rain, enters into the soil, which it fertilises; but in those villages where these substances are left on the streets, exposing the population to its emanations, produced by the action of the rain and other atmospheric influences, it becomes a source of very great danger to human life.

Sewage in Western Africa, and Freetown in particular.

But it is in large towns that it becomes essentially a question of life and death, which should call forth the energy and ability of both Government and people to stay the mischief that will arise from it. In many places in Western Africa—say, for instance, Freetown, in Sierra Leone—there is no proper organised means for removing the sewage of the town; all the inhabitants, or the ninety-nine in a hundred, use cesspools, which consist of a large hole dug in the ground in the immediate vicinity of the dwelling-houses, or connected with them; the hole being covered by a wood work or frame. These open privys are some of them full, and most in a state approaching it. There are, it must be distinctly remembered, no legislative Acts compelling the population to keep them in order and in a proper sanitary state; no Government inspection has ever been made of them; and in consequence of this, and the apathy of landowners and inmates of dwelling-houses as regards the removal of their contents, and their total ignorance of the use of deodorisers and disinfectants, the sewage of Freetown becomes the source of a pernicious emanation, and the chief cause why, at certain seasons of the year, fevers of the most virulent type always break out. It is strange that the European inhabitants, whose lives are so much imperilled

and jeopardised, have not long before this endeavoured strenuously to rouse the local Government from its apathy on this point. It is a question of life and death, and I, consequently, bring it prominently forward here for their notice and consideration. An organised system of sewage removal must be adopted; a legislative Act compelling the use of cheap deodorisers and disinfectants should be enforced; and not till the local Government condescend to think on these apparently small matters, will any real improvement in the healthiness of the climate of Freetown take place.

Quantity of urine and fæces excreted in Freetown in twelve months.

The population of Freetown may be put down as 20,000. If the average daily quantity of excreta be, per each individual (man, woman, and child), 2½ ounces of fæcal matter, and 40 ounces of urine, these 20,000 people excrete every day 3125 lbs. of fæces, and 5000 gallons of urine; or, in a year, 500,000 tons of solids or fæces, and 1,825,000 gallons of urine. These figures show only the excreta for a twelvemonth of the population of Freetown. But the cesspools are far from being emptied yearly. Five, six, seven, eight years' accumulation, and even more, are continually found in the city, with little or no use of deodoriser or disinfectant; and do these increase the health of the town and country around? or do they not add immeasurably to all the causes already enumerated in making the place, as one fantastic writer has called it, "a Golgotha and a Gehena?"

Besides the fæcal and urinal discharge of man, there are exposed, in various parts of the town, excrementitial discharges of various kinds of lower animals, refuse vegetable and animal matter in various stages of decomposition, and the blood of animals.

Ultimate composition of sewage.

The ultimate composition of the solids and fluids of sewage are—phosphates, urates, ammoniacal salts, salts of potash, soda, lime, magnesia, and alumina, silica, oxides of iron and of zinc, sulphuric or phosphoric acid. Besides these there are gaseous bodies emitted, consisting principally of the most deadly poisons, and which form the source of

epidemic diseases, viz., carburetted and sulphuretted hydrogen, free ammonia, &c.

I shall now consider the conditions of the various colonies and stations :—

Bathurst—River Gambia.

Gambia, soil of.

The geological structure of St Mary's and the countries in its immediate neighbourhood is strictly alluvial deposit, which must have taken place during several centuries, being brought down by the great river which flows through the country from the interior. Beneath this is a layer of clayey laterite. This process of formation can at present be observed in the lands lately rescued from the river by Colonel D'Arcy; an alluvial soil, covered with a little sand, will be seen, and if the land be dug for any depth, a more or less clayey substratum will be found. At a short distance from the surface the soil is very moist, except during the hot weather, when the powerful rays of the sun dry everything, and the temperature becomes very hot. In some parts, such as the Cape, the soil is more clayey, and contains a small quantity of iron ; but the alluvium is generally of a silicious nature.

Far in the interior countries of the Gambia the soil is composed of clay, which in the hot season becomes very hard ; in many places the soil is composed of the debris of soft red sandstones ; in other places, especially near the river, it is wholly composed of alluvium, with a clayey stratum beneath. The Island of M'Carthy's, formed by the bifurcation of the river Gambia on its course through the country, has an alluvial soil, intermixed with dense clay, which during the hot season becomes so dense and stiff that the roads appear to be macadamised. The soil contains some quantity of magnesia or lime in its composition, with a small quantity of iron. The rocks are principally of red sandstone, but farther in the interior, and at the falls, they consist of a conglomeration of gravels, made to adhere together by the intervention of clay under very great pressure, and are of very recent formation. These conglome-

rates are easily crumbled into their original parts by very slight force.

In the interior countries, from Vintaug Creek, through Tendabah to as far as Sulubalong, the rocks consist of clay intermixed with a small quantity of sand, but generally they are in greath depth. I saw specimens from the wells at Bye and near Tendabah. In these regions I have also picked up broken pieces of rough sandstone, containing large quantities of silicate and iron; these must have occupied important strata in the configuration of the soil. Mungo Park, in his travels in the interior, gives an account of an extensive stratum of quartz in the interior of Senegal, in the country of Manding, about which gold is found. This corresponds with the stratification of the countries of the Gold Coast and those along the Kong Mountains in Soudan.

These are conditions which do not speak well for the healthiness of this station. The alluvium with laterite is well known to be very malarious in its nature, and, consequently, it is no wonder that the Gambia Station, as well as that in the interior—M'Carthy's Island—should be so unhealthy. The country is plentifully supplied with water, which is obtained from creeks, or by digging at some distance from the surface. At St Mary's water is obtained by digging a short distance from the surface; but it is very unwholesome and very brackish. During the dry season the river water is very clear and wholesome at some distance in the interior; but during the rains it passes through the country with such velocity and force, receiving tributaries from various parts, and the natural drains from the whole of the country, caused by the heavy rain, that it is very muddy and unwholesome, unless allowed to settle, and then passed through a drip stone.

We have seen that sandy soils which contain clay a few feet from the surface, and are always kept moist by the evaporation which is continually going on from the moist clay below, are very malarious and unhealthy, fever of the intermittent and remittent type being very common in the region. St Mary's

has this kind of soil, and the clay is continually kept moist by a sort of subterranean current from the river, but its unhealthiness is very much checked by being covered with the bahama grass.

The soil is generally cleared once a-year by burning, and left exposed to the powerful heat of the sun, which dries and cakes it. It is under cultivation only for four months in the year, viz., from June to September, but some plants do not come to perfection before the end of October and November.

There is no proper system of cultivation adopted; it consists only in raising the earth with the common hoe, just sufficient to cover the seed. No ploughing is to be seen anywhere, and the soil is not raised to any great depth so as to allow the sun to decompose the materials necessary for fertilisation. The farmers are perfectly ignorant of agricultural botany, and do not change their crops in order that each might take from the soil the different inorganic matter which it contains, according to the nature of the plant. When the soil is deprived of nutrient material, they do not keep up its fertility by artificial means—by manure, but shift their ground and cultivate new pieces.

The cultivation is very limited, and consists principally of rice, Indian and Guinea corn, ground nuts, and a few vegetables.

The population of British Gambia is very small, but it is surrounded by large tribes, who occupy small towns of mud huts scattered over the whole of the country.

Drainage of St Mary's.

The drainage of St Mary's is excellent, and consists of mason work, plastered on the sides, and of great durability. Through the indefatigable exertions of Colonel D'Arcy, the late governor, this great work is fast approaching a rapid completion. The drain passes through the centre of the streets, but, unfortunately, it is not covered. Of the condition of the main drain, Colonel D'Arcy in 1864 said, that through the able and zealous exertions of the acting Colonial engineer, it has considerably advanced. "It is nicely faced, of good depth, and acts well.

It is nearly half way completed. When the facing reaches the Box Bar, or large sluice gate, it will be a most important public work carried out. The fall is so very trifling that the water flows only by its own weight. The drain acts somewhat sluggishly after the masonry is left behind." He advises the continuance of facing the sides and flooring with bricks, as the level will thus be increased, and the water be made to flow quicker. This, I think, should be more quickly attended to, as the exchequer of the colony is now healthy. It is frightful after the rains to see the centre of the town, where was formerly the race-course; there is always an extensive sheet of water for half a mile, which the sluggish drain could not remove.

Drainage of M'Carthy's Island.

The drainage of M'Carthy's Island and Combo is very partial, and consists principally of gutters made for the water to run through. There are during and after the rains stagnant pools and considerable swamps everywhere, which, by proper drainage, can be made to empty into the river. There vegetable and animal matters become decomposed, and give out very deleterious odours.

Public water-closets.

At St Mary's there are a few public privies for the common people and travellers, but the respectable inhabitants use private water-closets. Of the former Colonel D'Arcy wrote:—"In 1859 my first measure was to erect a public privy on the beach, contiguous to the market-place, for the convenience of the numerous travellers from the mainland, who so constantly arrived here for the purpose of trade and other lawful occasions. Subsequently, and at intervals, I erected three other similar buildings; their localities are well chosen, not the least smell is ever detected; but I grieve to confess that the smell of the great privy is constantly complained of." He considers the smell to proceed from the slaughter-house, and not from this flushed privy.

He recommended the following improvements to be made:—

First, To convert the present slaughter-house into a depôt for the market women to house their valuables at night.

Second, To change the great privy into a slaughter-house.

Third, To erect a necessary opposite the Mission Boat-house, on wooden piles, in the sea, so that the soil may be carried away by the ebb tide.

The soil of the Gambia is dark, and contains a good deal of organic matter.

I have before stated that Colonel D'Arcy had reserved a large tract of land from the marshy Pontine Swamp, which surrounds the town of Bathurst. He has, by dividing the land into lots and selling them, brought a large sum to the colonial chest; but this exposed alluvium, on which the population cast all the debris and filth of the town, so as to make it solid and prevent the rain from flooding it, will for years form a great source of the most virulent form of malarious poison. The physical, intellectual, and social degradation which the inhabitants occupying the neighbourhood of this marsh are subject to, might justly be compared with the condition of the inhabitants in the insalubrious localities of the true Pontine Marshes of classic Italy, as described by Montfalcon :—

"An inhabitant of La Bresse [*sic* Bathurst, especially of European extraction] suffers from birth, and exhibits from the first days of existence a deep impression of the unhealthiness of the climate. Scarcely has he quitted the bosom of his nurse than he languishes and gets thin. A yellow tint tinges his skin and eyes, the viscera become engorged, and he probably dies before he has attained his seventh year; or if he attains this age, he does not live, but vegetates; he continues cachectic and œdematous. Subject to putrid and malignant fevers, to endless autumnal remittents, to passive hæmorrhages, to ulcers of the extremities, which heal with great difficulty, the miserable being is scarcely able to fight against the diseases which convert his life into a prolonged dying. Having, perhaps, arrived at his twentieth or thirtieth year, disorganisation commences, his faculties become enfeebled, and generally the age of fifty years is the conclusion of his days. 'We do not live,' said a miserable inhabitant of the Pontine Marshes, to a

stranger, astonished that existence could go on in so unhealthy a region, 'We do not live—we die.'"*

Sierra Leone.

Soil of Sierra Leone.

The soil of Sierra Leone is composed principally of red clay, having a large quantity of iron in its composition. This is characteristic of Freetown, the capital. In the mountain it is composed of the disintegration of dark and blue granitic rocks, which are found abundantly in their elevated hills. At Waterloo, Hastings, and Wellington, in some places the soil consists of black alluvial loam, which are deposits from the Sierra Leone River and the several rivulets which join it. Towards the Cape, Aberdeen, and the countries around, the soil is alluvial beneath, but covered with sand.

Specimens of soil from Sierra Leone, examined by the late Professor John Bowman, of King's College, London, prove that it contains large quantities of oxide of iron. The following is the result of the different specimens examined :—

No. 1	contains	8·84	per cent.	of oxide of iron.
2	,,	26·00	,,	,,
3	,,	11·48	,,	,,
4	,,	23·20	,,	,,
5	,,	29·00	,,	,,
6	,,	46·12	,,	,,
8	,,	6·92	,,	,,
9	,,	11·56	,,	,,
Another No. 9	,,	12·48	,,	,,

This last Professor Bowman describes as taken up at the rising of the hill below Mr Melville's farm, not far from the Regent Farm Road, and a fair specimen of the earth of the colony. That in the bottle, with no label, but which is probably No. 7, contains 11·00 per cent. oxide of iron.

The rocks at the burial ground below Melville Farm or Mount Oriel are an extensive layer of the magnetic iron-stone,

* Morell, p. 618.

out-crops of which are found behind Government House or Fort Thornton; and by the disintegration of these iron rocks, by the constant action of the sun and other atmospheric influences, the soil is highly impregnated with iron. Besides the ferruginous rocks, there are the black and blue granite, which are extensively scattered in the lofty and conical hills behind Freetown, and in every part of the colony; they are hard and compact, composed of augite and felspar, with quantities of magnetic or titanic iron; they are excellent for building fortifications, and Fort Thornton, or Government House Battery, and East Street Battery, are constructed with then. We find next extensive strata of hard red sandstone in every part of Freetown, and of the colony generally. They are used principally for building purposes, and resist for a considerable time the action of the elements. Some of these red sandstones in certain localities are softer than others; they present different hues also, being very dark red or light red. In some localities a fine white sandstone, not of very compact texture, is to be seen. A specimen exists now in the out-crop through the water-course at Kissy Road Bridge.

In 1845 the following replies to questions were sent through Sir Charles Trevelyan to Sir Ranald Martin, from the Medical Department of the colony:—

Question 1. What is the geological character of the soil in and round the settlement?

Answer. Above high-water mark, red earth; below high-water mark, black mud; flats and valleys, black earth.

Question 2. Does ferruginous or red sandstone prevail, or red earth?

Answer. Red earth; red sandstone in the strata (used for building) underneath. Occasionally large blocks and some strata of blue granite (now used in building).

Question 3. Is the soil of the most unhealthy stations of a ferruginous nature?

Answer. I have never heard any one station in this colony called less healthy than another.

Question 4. Does the soil of the valleys or flats partake of the ferruginous character?

Answer. Yes.

Question 5. Do the low lands emit any offensive gases or smells, and if so, at what period of the twenty-four hours?

Answer. The mud by the river bank smells when exposed to the sun at ebb tide.

Question 6. Does magnetic iron exist, and if so, is the variation of the compass affected by it?

Answer. Yes.

Question 7. Has the nature of the soil in general, or of the most unhealthy localities in particular, been chemically analysed?

Answer by Dr Fergusson. So far as I know there has not been any minute analysis of the soil of this colony beyond the general one, that the soil is ferruginous, gravelly in some parts, loamy in others, in others sandy, but in all ferruginous.

The red soil of Freetown, and of the hilly portion of the colony, possess very little organic material, or none at all, because the effect of the iron in its composition is to decompose or dissipate these noxious substances, which are the essential source of disease; but on account of the great mortality of this part of the coast, and judging from other evidences, Sir Ranald Martin advanced the theory long ago, that ferruginous soils are most unhealthy, and explains, that in certain climates and localities the decomposition of the organic material by the iron, together with the magnetic phenomena elicited by heat and other agents, may lead to development of disease, especially fever.

Ferruginous soils unhealthy.

In the case of Freetown, as well as in the occurrence of fever on board the "Albert," within a short distance of the ferruginous sandstone red cliff of Iddah in the Niger, during the expedition up that river, we might easily explain the source of this paroxysmal visitation independently of the composition of the soil. I have throughout the preceding chapters endeavoured to bring to light all those causes which lead to the

constant development of fever in Freetown; the ferruginous and gravelly soil is very dry, contains little or no organic matter in its composition, and is elevated for the most part in every direction. Malaria cannot easily be generated from the soil itself, except in those marshy spots already described. It is favourable in every respect as a healthy soil. The "Albert" having passed through the swampy delta of the Niger to the interior, amidst all the swamp and mud alone, its whole water course cannot be expected to escape the effects of malaria which is constantly generated from it; its manifestation opposite the ferruginous high land of Iddah is no proof that the nature of the soil was the immediate cause. From a careful examination of several ferruginous soils in intertropical Africa, and from tracing out all those causes which are likely to lead to development of disease in those localities, I am led to deny the theory that ferruginous soils are unhealthy, or that they are productive of disease, especially fever, and hold, on the contrary, they are the most healthy soils in the tropics, all other things being equal, and would strongly recommend their selection in cases of cantonment or sites for building.

Sherbro, soil of,

The soil at Sherbro and the new station at Quiah consists of alluvial deposits, intermixed with clay; it is in some parts of a dark loamy character, rich in organic material; the country is level, but swampy during the rains, and covered with vegetation.

Cultivation.

The cultivation of the soil, although it is not systematically carried out, is more constant than in most parts of the coast during the rains, and, in fact, at any time of the year the markets are plentifully supplied with excellent vegetables of every kind. The soil is generally poor and barren, but manure of cow dung and other substances are employed to enrich it.

But there are no extensive plantations in Sierra Leone itself, except in its neighbourhood, where in Bulum, Mallacowrie, and the Scarcies, extensive rice and ground-nut farms are in cultivation during most part of the year. In the market of Freetown are to be obtained oranges, limes, pine-apples, coffee, yam,

cassada, arrowroot, vines, sweet potatoes, guavas, water-melons, water-cresses, peppers, ground nuts, bananas, plantains, tamarind, ginger, cabbage, papaw, rice, Guinea corn, Indian corn, sugar-cane, love apple, rose apple, plums, beans, ochra, millet, cashew-nut, cocoas, pumpkin, mango, locust, Kola nut, naseberry, cucumber, sweet sop, sour sop, and many other vegetables.

Population.

The population of Sierra Leone is from 40,000 to 50,000; the capital is Freetown, which numbers one-half the whole population, over 20,000; the interior villages are very thinly inhabited. In 1808 Sierra Leone was made a depot for negroes taken out of slave-ships. In 1811 its population was 4500, half of whom were liberated Africans. In 1833 the population was 29,764, and in 1861 it was 42,000. In every part of the coast emigrants from Sierra Leone are to be found. Between June 1812 and January 1833 the number of slaves liberated there was 27,167.

Drainage.

In 1863 Governor Hill, in his report with reference to the several classes of colonists at Sierra Leone, said "that effective water-courses have been made throughout Freetown and its precincts; drainage has been extensively improved, and thus many causes of disease are prevented." I have looked in vain for these improved drains so described, and I can say that there are no good drains to be found anywhere; in the civilised acceptation of the word, there are neither drain-pipes nor water-pipes. Freetown being elevated, there is a natural drainage from the water seeking its own level; there are open gutters produced by digging the earth on either side of the main road, without any mason work, and the heavy rains of the rainy season wash the filth from the surface, accumulated during the past dry season, into these so-called open drains, from which they are carried to the river. If the quantity of rain is small, as in the beginning and after the rains, these filthy decomposing matters are kept constantly in the open gutters in front of each dwelling house, and not having sufficient water for their removal, they become the foci of epide-

mics, presenting the very conditions which are necessary for the nursery epidemics of fever, &c.; but the local Government have not thought it time to have a well-organised sanitary administration, and well-organised sanitary police: the climate, therefore, must be the scape-goat for the neglect, and we must say, like Sir Charles Napier, that "the effects of man's imprudence are attributed to climate; if a man gets drunk, the sun has given him a headache, and so on." As in Delhi, so must we say of Freetown, "every garden, if not kept clean, becomes a morass, weeds flourish, filth runs riot, and the grandest city in India [*sic* Africa] has the name of being insalubrious, although there is nothing evil about it that does not appear to be of man's own creation."

Water supply.

Water, in the form of springs, is abundant in various parts of Freetown, and the quality is pure and excellent. It is the best to be obtained in all the West Coast, but there are no water-pipes to conduct it into the various public places where it is mostly required. It is not conducted into the buildings of the town, nor is it used for any sanitary purpose. The people cannot do these things, but the local Government can do them. Freetown requires good water supply, drainage, paving, and thorough cleansing, proper and approved healthy plans of building; and, as Miss Nightingale says of India, so I say of Freetown—the work is urgent. Every day it is left undone adds its quota of inefficiency and death-rate to the Europeans and its thousands of native population. The danger is common to Europeans and to natives. Many of the best men Sierra Leone ever had have fallen victims to the same causes of disease which have destroyed the native population. And so it will be till the local Government has fulfilled its vast responsibilities towards the population, who are no longer strangers and foreigners, but subjects of Her Majesty the Queen.

Water-closets.

There are no public water-closets, as we find in the Gambia, and the private ones, as we have seen, are never, or very seldom, emptied; and during the drying process, after the

rains, they become the most pernicious source of disease. It is about the commencement of the south-western monsoon, when the drying process has been continued for some time, and the mountains prevent the wind from removing from the town the noxious vapour that is exhaled from sewers and other fever-producing sources, which now become intensified in their operation, and become so many foci for pernicious development, that in March and April the cry of epidemic visitation, as evidenced by the number of deaths amongst Europeans and native population, rings yearly from one corner of the town to the other.

The Gold Coast.

The soil of the coast from Cape Palmas to Winnebah consists principally of the decomposition of granite and felspathic rocks. There are here and there to be found volcanic scoriæ undergoing various degrees of decomposition. Gold Coast.

"There is very little difference in the soil along the coast," says Dr Tedlie, "from Cape Palmas to the River Volta. Within four or five miles from the shore it is of a silicious nature; the clumps of hills, which are to be met with in every direction, are composed of gneiss and granite; mica is found to enter into the composition of some. The rocks, from containing large proportions of felspar and mica, are rapidly passing into decomposition; such, more especially, as are exposed to the influence of the air, rain, and water. The result of this decomposition is the foundation of the argillaceous clay. On receding from the sandy shore the soil is silicious, mixed only with some decayed animal and vegetable matter, where no granite or micaceous rocks intervene. It is in the valleys that the rich alluvial soils are to be found, formed of decomposed materials of the surrounding hills, washed down by the heavy torrents of rain, which are deposited with the matter of vegetable decomposition, and afford great richness to the original mould."

In some of the hills the soil is composed of red earth containing, in minute subdivision, ferruginous hornblende; the

hills rise from abrupt bases, and are in a great many cases conical above; in other places the soil consists of a dark rich loam, highly charged with organic materials as well as the disintegration of the felspathic rocks which form the principal strata. In Ahanta, and in all the Gold Coast to as far as Winnebah, the principal varieties of rocks are decidedly of igneous origin, being chiefly made up of trappean and metamorphic rocks, interspersed amongst which are rocks of the Silurian and Devonian systems.

Igneous rocks.

"The trappean rocks occur in connection with the stratified formation in disruptive masses; they are principally compact hard basalt, augitic in composition, and impregnated with a small quantity of iron; amongst them are also a good number of rocks which are felspathic in character, viz., *the diorites.* These, from their composition, viz., of augite and felspar, present a brighter appearance than the black basalt.

"The metamorphic rocks, which have undergone a very striking metamorphosis in the original sedimentary character of thin strata, are chiefly quartzose rocks and gneiss. The latter is very common in Ahanta and Fantee. They are tough, hard, and crystalline, and composed of quartz, mica, felspar, and hornblende, having curved and flexured lines of stratification. The quartzose rocks are granular, and present a more determined stratification than the gneiss; they sometimes have bands of conglomerate structure and beds of mica flakes. The gneiss and quartzose rocks are hypothetically believed to be the product of the disintegration of granite rocks."*

Interspersed and lying in close proximity with the beds of these quartzes, especially at Anamaboe and Cape Coast, are fine conglomerate sandstones, which are used for building by the natives; these lie in layers of considerable depth, and are stratified. Some of the layers are very soft, and easily crumble under the pressure of the finger, leaving a residue composed of sand and small mica schist. These are perfectly black, specimens of which are now to be seen on the water edge of Ana-

Conglomerate sandstones.

* "Geological Constitution of Ahanta, Gold Coast," by the Author.

maboe. The hard variety of sandstone is black, spotted white, which consists of varieties of composite silicates.

The quartz rocks found in this locality differ in many cases materially from those found in Ahanta. Some are conglomerates composed of gravelly silicates, which must have been fused together under very great pressure; each gravel can with ease be distinguished, and, if necessary, separated by the use of force; they are united together by silicious stroma or cement. The next variety is the common quartz, where the original particles are not very distinct. These have undergone a greater degree of fusion under intense heat, but not sufficient to destroy or fuse the original particles. The third variety is conglomerate in structure, but possesses a large quantity of broad sheets of mica and felspar, which are easily divided into thin semitransparent plates. This variety is very common at Anamaboe. These flakes, which contain a large quantity of peroxide of iron, are undergoing rapid disintegration and decomposition through the effect of the sun, the air, and the rain. The quadrilateral space at this station is covered with the disintegrated particles, and during the dry season the ground seems to be all brilliant shiny flakes, which reflect the rays of the sun, and produce an unpleasant glare. They attract heat a great deal, and at midday, before the south-west sea breeze blows, the radiation from the earth is excessive.

Volcanic lava.

In the argillaceous covering of the volcanic hillocks which surround Cape Coast, lava is here and there scattered in broken masses. They still maintain their brilliant shiny appearance. They prove, without a doubt, that these formations were volcanic, and that one or more craters were in the neighbourhood, from which these molten rocks must have had their origin. These fragmentary lavæ are scattered in the valleys, and are undergoing rapid disintegration by trituration and by the action of climatic influences.

In the interior other rocks are discovered, consisting of sandstones with a large proportion of clay in their composition;

they are extremely hard, especially those found in the interior of Ahanta and Axim, and contain much oxide of iron. Some of the rocks on the sea-shore are hard limestones, which are characteristic of the Silurian and Devonian systems.

Water supply.

As is characteristic of stations where clayey and metamorphic rocks are greatly found, there are numerous water-courses which present no water during the dry season, but in the rains are filled with water, and swell into rivulets. Water is difficult to be obtained; wells a few feet deep give brackish water. The inhabitants live principally on tank water collected during the rains, or obtained from swampy spots.

Soil from Winnebah to the Volta.

From Winnebah to the Volta the soil is composed of alluvial deposit, which consists chiefly of silicious matter, oxide of iron, and alumina. From Pram Pram to Shai, in fact all the plains in those regions, are stiffer and harder than those near to Accra and Christiansborg, from being mixed with a large quantity of clay. During the rainy season the alluvium is covered with vegetation, but during the dry the vegetation is burnt down, and the soil, being exposed to the rays of the sun, becomes very hard. At the foot of Shai Mountain the alluvium contains a large quantity of iron in its composition, and during the dry season so compact is it when broken, that it resembles a vast sheet of lava. It must be the product of disintegration of the micaceous rocks, which are the volcanic blocks composing the almost perpendicular mountain, washed down every season by torrents of rain.

Soil of Accra and Christiansborg.

Between Accra and Christiansborg the soil consists of a barren red clay. The rocks are—1*st*, A fine white sandstone, which makes excellent drip or millstone grit, situated just under the fort—James Fort; extensively used both for dripstone and millstone by the inhabitants of the Gold Coast; they use it also for grinding beads. 2*d*, Several layers of clayslate, of very soft texture, with distinctly marked cleavage; the out-crops are very irregular, but they run from N.E. to S.W. 3*d*, Along the beach there are freestone, placed pell-mell in huge disruptive masses.

Cultivation is carried on to a very limited extent in the Gold Coast, especially in the sea-board towns, and this is principally owing to the limited supply of rain and the barrenness of the coast lands. In the interior, however, the natives work well; but their mode of cultivating the soil is as unscientific as in the other parts of the coast already described. There are no extensive plantations to be seen anywhere near the sea-coast towns, except, perhaps, in the plains of Winnebah. At Accra, through the exertions of the Basle missionaries and Mr Freeman, systematic plantations are in existence, which serve as models to those parts of the coast. Several thousand coffee trees are at present under proper cultivation. Mr Freeman has got vines, pine apples, cotton, coffee, cabbage, &c., under skilful and civilised management in his plantation at Beula, which supplies Accra plentifully with green vegetables.

Cultivation of the Gold Coast.

Of the green vegetables used on the Gold Coast by the natives, an anonymous writer in the *African Times** gives the following:—"First, though not foremost, there is the *wild cabbage* (called by the Fantees 'Empompo'), the leaves of which make a capital salad, or, dressed as greens, make a good substitute for the savoy. It is to be had in perfection from the end of May to the end of February, *i.e.*, nine months in the year. Second, the *wild cucumber*, little inferior, indeed, to the cultivated one; it makes a good salad, and eats well also stewed with a little melted butter. Then we have the *samphire*, the *sea-kale*, or *mirenchie*, growing even down to the very beach. *Purslane* is also very abundant, and very wholesome, and grows everywhere and anywhere. *Spinach*, also, which the natives call *kotú betlow;* and the love apple (tomato), or *enkrooma*, for seasoning soups, or making stews, roasting, frying, &c. The *green papaws*, served with boiled mutton and dressed as turnips, are by no means a bad substitute for that excellent vegetable, garden mallows, or vegetable marrow. *Cabbages* of very fair quality, from the tree cabbage, to be had at most of the native farms. *Sweet potatoes, green corn*, or

* Vol. iv. No. 37, p. 22.

young corn dished up as green peas, makes a very respectable appearance. *Beans, calavanças, mazagan,* and *haricot;* these are to be seen daily in the market at Cape Coast, dressed up in some native dish, but the European can get the raw article and dress it as he pleases. The leaves of the *Capsicum annuum,* or *pepper plant,* make a good salad; and when boiled and served up as spinach, they make a very palatable dish. *Palm cabbage,* which is the top or head of the palm tree; it makes a very choice and delicious vegetable, and eats well with fish, flesh, or fowl. There are several kinds of yams, with as great a difference between the varieties as between the haricot and the Windsor bean. There is the *kökóé* (cocoe of the West Indies), or *yam cabbage;* the leaves make a good cabbage, and are used as such by the Africans; the root resembles the yam, but is more spherical, the yam being oblong; the flavour partakes something of a nice mealy potato, or a roasted chestnut. The *cassada,* when its meal is mixed in equal proportions of flour, makes a pastry, light, wholesome, and easy of digestion, and well adapted for invalids. *Plantains,* roasted, fried, or boiled, make a very good vegetable. *Bananas,* when just full grown, but not yet turned to ripening, make a passable imitation of carrot. There are *mushroom, shallots, chicory,* and *pumpkins,* all good vegetables," and can be obtained in various quantities and quality.

The population of the Protectorate Territory of the Gold Coast has been laid down at 400,000 souls, but there has not been any census taken. The inhabitants occupy small towns or villages, numbering from 40 to about 8000. In no one town, croon, or village, so far as my experience extends, can we find over 10,000 persons. The native huts are huddled together, pell-mell, without any plan; there are scarcely any streets or proper lanes, but, as a whole, only crooked by-paths. Cape Coast presents but a poor exception to this rule, where a few streets properly so-called are discernible; but that confused system of building, as seen in purely native towns, is conspicuous even here.

There is no regular system of drainage on the Gold Coast; the country being hilly, and the quantity of rain falling in the rainy season being small, the soil is generally dry. The native population are very primitive in their style; they go out in the fields, or on the sandy beach, to answer the calls of nature, and these fæcal matters go to fertilise the soil, or are washed away by the booming waves of the sea. The effluvia from these ochletic poisons are extremely disagreeable, and in many cases blow to the teeth of the town. Colonel Conran has prevented these nuisances from being done indiscriminately in every part of the town, and has made several public privies in the various suitable localities in the outskirts of the town. Among the higher classes, the use of privy cesspools, made by digging deep into the earth, such as are found in the houses and premises at Sierra Leone, is unknown; they use closed chambers, which are emptied into the sea once or twice every day, and are consequently free from the reeking poison which is constantly generated from that source. At Accra and its neighbourhood, where there are low-lying lands, a plentiful accumulation of water, in stagnant pools during and after the rains, always occurs. There are no proper drains here, and the country very much requires them. Drainage and sewage.

Lagos and the Bights.

The several stations in the Bights of Biafra and Benin are composed principally of alluvium intermixed with sand. The strip of land which runs from between the lagoon and the sea, extending from the Volta to the Niger, and including Lagos, had its origin primarily from immense quantities of coral forming their beds on the border of the ocean, and gradually raising that portion until it forms extensive reefs or breakers; these, by being constantly filled up with sand, debris, and deposits from the river, and washings from the soil during the rains, ultimately becomes rescued from the ocean. The sand is porous and white, and allows the accumulation of surface water, and during the rains forms beds for the swamps. "The Lagos and the Bights, soil of.

formation of land," says Dr Rowe, "is well shown in these lagoons, and may be traced through all its stages, in ascending scale, from the first step in the process to the existence of solid land. Not unfrequently, from the same point in clear water in the middle of the current, we see the growths from the bottom which perform the first step in the process; next to them, water lilies and other floating plants on the surface; long grasses come next as we approach the bank, and when once these have gained a footing, the work of solidification proceeds rapidly. Acres of shallow water are grown over with this grass; and from its margin, by the force of the current and the rise of water-level during the rainy season, are detached large masses, forming floating islands." This is a fair description of the surface formation; but the groundwork must be looked for to the incessant working of the madrepore corals, centuries ago, with which this part of the coast abounds. In the interior, the soil consists in some parts of dark clay, whilst in others, the clay is red; large blocks of granite are to be found in several places, and in most parts the soil is ferruginous. The

Cultivation and population.

inhabitants of this part of the coast, especially those in Yorouba, are very industrious, and cultivate extensively the land. Plantain, banana, papaw, oranges, limes, custard apples, mangoes, guavas, cashew nuts, pine apples, melons, and small cucumbers or ghirkins, tomatoes, onions, garlic, water-cresses, various kinds of spinach, bread fruits and bread nuts, edible yam, cassada (from which farina is made), pumpkins, maize, and small Chili pepper, sugar cane, are all to be obtained in large quantities in this part. "The vegetable productions adapted for supplies to the troops are maize, the Indian corn of the country, rice of good quality, yams, and cassada. The corn is used entirely by the natives. It is found cheaper to import flour than to buy and grind the corn. The natives, for use, soften it in water, beat it in a wooden mortar, and after boiling the pulp, which has been carefully separated from the husks, eat it either dry as a paste, or boiled up into gruel. It forms the morning meal of the population. It is a very

wholesome dish, but tastes a little acid from the fermentation which has taken place in the corn while soaking to soften. The meal of cassada, or cassava root, is the staple food of the natives. It is carefully prepared by washing, drying, and roasting, and is mixed, before eating, with hot water, when it swells into a mass. It is generally eaten warm, and with such vegetables, palm oil, fish, or meat, as their means permit. Meat is a luxury but seldom indulged in, except by the wealthier. Smoked fish are used largely; they are simply exposed, in an earthen pot with a few holes in it, to the smoke of a wood fire." The inhabitants are scattered all over the country in small towns, except in Abeokuta, where the population has lately increased to 100,000. In Ibadan the population is also large, but in all the other towns it ranges from 100 to 8000. The natives live in low mud huts, with thatched roofs, with a well-worked, hardened mud floor. Each hut has a verandah before and behind it. They are built in groups on four sides, enclosing a quadrangular space. The huts are generally kept very clean.

Native huts.

Drainage and sewage.

The drainage of the country around is most imperfect. In fact, there is no drain whatever. During the rains the water freely accumulates in different parts, and is left to be dried up by the sun, which by no means improves the healthy condition of the place. The sewage is scattered all over the town and streets, consisting of the excrement of men and animals, and increased by the filthy habits of pigs, which are let loose everywhere here. The effluvia from it is very sickening and destructive, and consequently the inhabitants are very short lived. Lagos and Abeokuta are greatly in advance in these respects. In most of the towns the streets are narrow and very crooked, but here and there in the outskirts, in open spaces, shaded by numerous cocoa-nut plants, men, women, and children may be seen parading about.

Water supply.

Good water, but slightly brackish, is abundantly obtained. Shallow wells from two to four feet in depth, and funnelled by a cask to fit, open on both ends, give a continual supply of water.

In Bonny and the delta of the oil rivers, the soil is principally alluvial; lower down, however, it consists of argillaceous clay.

Sewage Deodorisers and Disinfectants.

Various substances have been used to prevent the decomposition of sewage, and check the ammoniacal compounds generated from it; and for the benefit of the inhabitants who would like to destroy the evil results arising from their privy cesspools, I shall here detail them :—

1. *Quicklime and Water.*—These should be added until a deposit takes place, and a clear supernatant fluid remains. Here the lime, by combining with phosphoric and carbonic acids, forms insoluble salts of lime, which are carried down, and ammonia set free. The liquid contains salts of potash and organic matter, which after a time becomes decomposed. To one gallon of sewage add always sixteen of quicklime. This is a process which is easily performed in tropical Africa, and which should be enforced by legislation.

2. *Dry Earth.*—When perfectly dry it answers well mechanically, especially when marl or clay is used; but it soon loses its power by being clogged.

3. *Charcoal.*—This produces effects similar to dry earth. Animal charcoal is the best, and then peat.

4. *Cheap Salts of alumina and then lime; or Manning's process—alum sludge, lime, and waste animal charcoal. Stothert's process consists in the addition of zinc and charcoal.*—This is a more expensive process.

5. *Sulphites of lime and magnesia in combination with products from tar, impure carbolic (or Phenic Acid), forming carbolates of lime and magnesia.*—This is M'Dougall's patent, and is sold in liquid and powder. It is one of the best disinfectants that could be used for sewage.

6. *Superphosphate of magnesia and lime-water, or Blyth's patent.*—This is very expensive, and practically not of very great use.

7. *Perchloride of Iron.*—This is one of the best disinfectants that could be used for sewage. When added to it, the carbonate of ammonia precipitates rapidly peroxide of iron, which carries down with it the suspended matter, leaving a clear fluid above. Both this fluid and the deposit are perfectly free from odour. The sulphuretted hydrogen is deposited in the form of sulphuret of iron.

Besides the above, other substances may be required to purify the air, but which are too expensive to be used in sewage.

8. *Lanaude's Disinfectant consists of solutions of permanganate of potash, chloride of zinc, nitrate of lead, and perchloride of iron, and a mixture of sulphate of zinc and sulphate of copper.*—Its effect is limited.

9. *Ledoyen's Fluid, or nitrate of lead,* is composed of litharge, 1 lb.; strong nitric acid, 7 oz.; and water, 2 galls. It acts rapidly, and with certainty.

10. *Burnett's Disinfectant Fluid, or chloride of zinc,* is a very powerful substance, one part of which should be added to eight parts of water when about to be used. Each fluid drachm of the disinfectant contains 25 grains. It destroys organic matter and ammoniacal compounds.

11. *Condy's Fluid.*—A process by which the permanganate of potash or soda gives off oxygen; its chief constituent, therefore, is "condensed oxygen." It is a most powerful deodoriser and disinfectant; it is not poisonous, nor evolves any noxious smell. It destroys organic matter powerfully and rapidly, and has an immediate effect in decomposing ammoniacal compounds. According to Professsor Hoffmann, if the permanganate of soda is placed in the mouth, it takes away or destroys the odour of tobacco. Added to impure water, especially when travelling in the tropics, it purifies it at once, and therefore should be more generally used.

12. *Chlorine.*—This is one of the most powerful deodorisers we have; it decomposes sulphite of ammonia and sulphuretted hydrogen rapidly, blanches organic pigments, and destroys organic odours.

Preparation of Chlorine.—Mix two tablespoonfuls of common salt and two of red lead with one quart of water; stir them well, and then gradually add half a wineglassful of sulphuric acid. Chlorine is evolved, and absorbed by the water, from which it is slowly given out, and might be kept in a stoppered bottle or jar, and left open when required to be used.

13. *Nitrous Acid, or hyponitrous acid of some authors.*—It has a most powerful effect on organic matter, and deodorises perfectly. Its odour is irritating to the lungs, and in some persons might cause headache, nausea, and vomiting. The simplest way of preparing it, is to add a bit of copper in nitric acid, and a little water.

14. *Iodine Vapour.*—Place a small quantity on a hot plate. *Sulphurous acid.*—By burning sulphur. *Vinegar* and *ammonia*. These three substances are of more or less value.

15. *Ozone.*—This is the most efficient deodoriser and disinfectant we have. It destroys all oxidisable mephitic emanations and miasmatic exhalations. It is supplied by nature; of how it can be artificially prepared, and some account of its property, I shall hereafter speak.

Suggestions to the Sierra Leone Government for effectually removing its Sewage, and consequently removing one of the most pernicious causes of the disease in the colony.

1. The first movement should be a legislative Act, making it compulsory on all owners or dwellers of houses to have their privy cesspools emptied once or twice every year, under the immediate supervision of the Government; and if once a-year, it should be done in the month of November.

2. That the fæces and urine, or the sewage, be removed from the privies, and collected in proper carts provided by the Government for that express purpose, under the superintendence of the Officer of Health or his subordinates.

3. That, as the water-closets are made as I have above described, the dry process shall be the only means employed for the removal of the sewage which they contain.

The contents of the cesspool should first be mixed, in sufficient quantity, with one of the disinfectants or deodorisers named above. Lime, charcoal, or M'Dougall's patent (carbolates of lime and magnesia), will be found very expensive, and consequently I should recommend that surface earth, consisting of clayey or marly soil, should be well dried and baked in an oven, and thrown into the water-closets in sufficient quantity to precipitate the solid constituents, and dry up the liquid. The hardened solid material should be removed into the Government cart, and thence into *poudretta* manufactories, or conveyed at once to the soil. Mixed with dried clay, the sewage becomes an excellent fertilising manure, which might be sold to farmers, or employed in the model-farm already recommended to the Government.

4. In process of time, the Government might recommend, and see carried out, especially in houses in the centre of the town, a standard form for water-closets, by which the sewage might be very easily removed—something like what was proposed in 1858 by the Bengal Government.

5. That owners of houses be made to pay a small tax, if found necessary, towards this cleaning, and the Government should principally employ the numerous prisoners who infest the jail of Freetown for this purpose.

Necessity for sanitary reforms.

Inspectors of market and stock.

That Sierra Leone is groaning under a want of material sanitary reforms, and that within the last few years the health of the colony has deteriorated in a marked degree, may be proved from the following quotation from the weekly paper, *The Observer*, of August 2, 1866 :—

" This colony, we are sorry to state, has not improved with respect to its health. Fevers and dysentery are still known amongst us, *but we employ little or no means to get rid of them.* Unwholesome meat is still sold in butchers' stalls, and paraded about the town for sale ; there is no inspector of stock, or of meat, or of markets. A board of health is unknown to us, and sanitary inspectors more so."

With these facts before us, the editor asks, " Can there be

any surprise that fever and dysentery visit the colony?" "The present state of the butchers' market," he observes, "is most disreputable; the building is quite dilapidated, and the stalls where the meat is exposed for sale are most filthy. There is not the slightest convenience in these stalls; and what is worse than all, water is not accessible." The consequence is that they are never washed, and the quantity of dirt and filth accumulated in them is such as to shock the nerves. "The malaria arising from the quantity of filth must, as a matter of course, not only infect the meat, but must be injurious to health." The public have no guarantee that the animals killed are in good health and condition. The cattle plague has been busy amongst the herds in the colony, but "there are no inspectors to inspect and look over the beasts slain. Why could not a diseased animal be imported into the market, killed, and sold? Again, in the butchers' market the stalls are quite exposed; there are no doors; and a butcher who cannot sell his meat during the day takes it home, or to any unwholesome place for the night; carries it again next day to his stall, and exposes it for sale. It may be that at his residence yellow fever or any contagious disease reigns; it follows then that the meat becomes also infected, and passing into the possession of another, the disease, whatever it may be, is carried into another house, place, or locality."

Dilating on the injurious effects of filthy dwellings, he continues:—"What can be more pernicious to life than filthy dwellings and stagnant pools? The former are numerous in this town; indeed, even in the middle of the city the yards of several houses are in a most detestable condition. The latter are frequently seen in streets and roads not quite familiar to business men, and where the poor are in general congregated. Now, I ask, should there not be regular sanitary inspectors, not only to visit yards, and to see that they are kept clean, but also to inspect streets, roads, and lanes?" He predicts, without a question, that the health of the colony would be greatly improved if an inspector of markets and stock be also appointed.

CHAPTER VII.

PREVAILING WINDS — HUMIDITY AND SATURATION OF THE ATMOSPHERE—DEW-POINT.

Effects of winds.

ONE of the most important phenomena in the consideration of physical climate is the prevailing winds. By them the temperature of the atmosphere is properly adjusted—the dryness and humidity increased or diminished—clouds gather or disperse water produced by evaporation from the seas and oceans transported into interior of continents—noxious vapours and emanations are dissipated or made innoxious—and perfect ventilation in an otherwise close and sultry atmosphere is obtained.

How produced. Trade winds.

Winds are currents of air like those in water, produced by unequal heating, and by the tides and currents of the sea and rivers. Within the tropics, beneath the vertical rays of the sun, the air becomes rarefied, and made specifically lighter by the heat, and ascends far above; the colder and heavier air of the poles rushes towards the tropics in a perpendicular manner to supply the place of the heated equatorial air which has ascended. About 5000 or 6000 feet above the surface the heated air begins to recondense, and flows towards the poles. "The rotation, however, of the earth on its axis from west to east, deflects (on account of the increased velocity of the parallels of latitude near the equator, which have greater radii than the arctic parallels) the currents of polar air from their northern and southern course, and produces on the north side of the equator a north-easterly current, and on the south side of the equator a south-easterly current—both of which, as they approach the equator, gradually become more nearly parallel to

it, or east." To these currents writers on meteorology have given the name of *trade*-winds.

The equatorial currents, on their polar direction, take a westerly direction from the same cause, viz., the earth's rotation on its axis, until they become nearly west. They are called the *upper* or *returning trade-winds;* and the west-south-west, or westerly winds form the counter currents of the tropical east winds or trade-winds.

But the north-east and the south-east trade-winds do not blow from the same degree of latitude in opposite directions, but are separated by a space equal to about five or six degrees in breadth, which is known as the *region* or *zone of calms,* where rains and storms are plentiful, and where the heat is very great, other local modifications not being taken into consideration. The north-east trade-winds blow between 9° and 27° of north latitude, and consequently from Scarcies and Matacong, north of Sierra Leone to Cape Bojador, near Teneriffe, and about 19° north of Portendie, including Isle de Loss, Pongas, Nunez, Bularma, the countries under the Gambia and Senegal Governments. The south-east trade-wind blows between 3° north latitude and 25° south latitude, including the Gaboons, Fernando Po, Ascension, St Thomas, St Helena, Congo, and St Paul de Loango. The zone of calms is occupied by Sierra Leone, Liberia, the Ivory Coast or Grand Bassam, the whole of the protected territory of the Gold Coast, Awoonah, Dahomy, Lagos and the Yoruba countries, Benin, Egbo, Calabar, Cameroons, and the northern part of Fernando Po. Winds may be divided into three great heads, viz., constant, periodical, and variable. Their variations are produced by many causes, viz., by large extent of country—by the greater heat caused by reflection of land—by mountains—by the alternate heat and cold of seasons—and by rains. In India the year is divided into two halves by *periodie winds,* which have been designated the *monsoons,* which blow for six months in one direction, and then six months in the other. The monsoon is only a modification of the trade-winds, occasioned by its being disturbed in its

Various kinds of winds—Monsoon.

course by the large tracts of land presented by Africa and Asia, and by mountains; and to keep the equilibrium of the atmosphere, the wind takes opposite direction for six months, instead of blowing from east to west. From 10° to 23° south latitude, there being no land to disturb the wind, it blows constantly from east and south-east; but from 10° northwards to the equator, from October to April, north-west winds blow, and from April to October, south-west. North of the equator, to the tropic of cancer, a change takes place; south-west winds blow from April to October, and north-east winds from October to April.

"The south-west rainy monsoon, the most remarkable of our periodical winds," writes Sir Ranald Martin, "begins on the Malabar Coast in May, and reaches Delhi by the end of June, extending to the north-eastern parts of Affghanistan, but greatly modified. It prevails more in the mountains than the flats of the Punjaub. The hills and valleys of Cashmere have their share of it, and it gradually loses itself westward in the valley of Peshawur, where it appears only in clouds and showers. On the Coromandel coast it is retarded, the clouds brought by the south-west winds being detained by the Ghauts. It reaches Bengal by the 15th of June." In the latitude of $11\frac{1}{2}°$ on the coast of Malabar, the rains are very plentiful, being not less than 123–5 inches in the year, and this is produced by the arrest of the south-west monsoon by the mountains, and the accumulation of vapour occasioned by it. As soon as the sun passes the southern hemisphere the direction of the monsoon is at once altered. "The mass of air which had been accumulated during the hot season and rains on the central platform of Asia, now bestirs itself, and moves towards the regions south of the equator, where the atmosphere has been dilated and dissipated by the solar heat." Over most parts of the Indian Ocean—the central platform lying to the north-east—the monsoon proceeds from the same direction, viz., north-east. In the seas of China, Borneo, New Guinea, and Java, it blows from north and north-west from their position to the central platform. In Assam and Behar

the prevalent winds are east and west; in South Bengal, north and south.

In the consideration of the prevailing winds of Western Africa, we have to divide the whole western course into three great sections, viz., the first, that portion which lies within the north-eastern trade winds, *i.e.*, from lat. 9° north to lat, 14° 44′ north; the second, within the zone of calms, from lat. 3° north to lat. 9° north; and the third, from lat. 3° north to lat. 0·36′ 10″ south.

Winds in Gambia region.

In the *first section*, including the Casamanza, the Gambia, and Senegal, the winds divide the year into two portions, exactly as the monsoon of the Indian Ocean. The first commences in October, and terminates in the end of April. During this portion of the year the wind blows from the east and north-east for the most part; occasionally only the sea breeze from the south-west blows in the afternoon. At the commencement of this monsoon, or the breaking up of the south-west monsoon, storms and tornadoes are frequent, and the wind fixes to the east and north-east, when it blows constantly for days from east and south-east by east, which it does in November, December, and January. The wind is dry, cold, and accompanied with thick haze, forming the harmattan, of which we shall hereafter speak. From February to April it blows a hot wind almost constantly from north-east, occasionally interrupted by the sea breeze, which is cool and refreshing. The second portion of the year commences in April, and terminates in October. At this time the prevailing winds are from south-west, west, and north-west; occasionally from north-east. These winds blow through the whole of the rainy season, and are moist, healthy, and pleasant, and are well charged with evaporation from the ocean over which they blow. Their commencement is marked with storms and tornadoes also, but the

Simooms.

rains are late and not plentiful. In April and May the simoom blows over this portion of Western Africa. It is exceedingly hot, and destroys vegetation, and blows from every point of the compass. Of its character I shall speak hereafter when writing on the hot season.

To show how variable the wind is at this time of the year, I have appended in full the observations on the weather which I made at Macarthy's Island, River Gambia, in May 1866:— Variable winds.

1. Strong north wind, varied round the compass in course of day.
2. N.E. in the morning; then S.W., N., and S.
3. N., N.E., noon; afternoon and evening, S.W.; night, N.E.
4. Sultry morning; S. in afternoon and evening; cloudy all day.
5. W. and S.W. morning; N. afternoon; sultry and cloudy evening; S.W. night.
6. N. morning; afternoon, E.S.E.; night, strong S.W. by S.
7. Strong S.W. by S. all day. Cloudy morning.
8. S.W. morning; afternoon, S.; thunder towards S.; tornado, evening, N. and N.E.
9. Very sultry all day; lightning, evening, S. to E.
10. N.E. during the day; strong S. and S.W. at night; lightning, evening, S., N., and W.
11. N.E. morning; evening and night, S.W.
12. Sultry all day.
13. S.W. in the morning; evening, N.E.; heavy rain at night.
14. Light N.E. in morning; evening, strong S.W.
15. S.W. all day.
16. S.W. all day; calm in evening; strong S.W. at night.
17. W. to S.W. during the day; strong N.W. at night.
18. S. to S.W. all day.
19. N. morning; S.W. and S. afternoon and night.
20. N.W. in morning; S.E. afternoon; S.W. night.
21. S.E. all day, very strong; blowing a gentle gale in evening.
22. Strong S.E. all day.
23. S.W. morning; strong N.W. in the afternoon and evening.
24. N.W. morning; N. evening; cloudy all day.
25. Sultry and cloudy all day, S.W. prevalent.
26. Cloudy all day; S.W. by S. blowing gently; a few drops of rain in afternoon.
27. S.W. morning; noon, E.; afternoon, S.W. by S.; evening, N.E.
28. S.W. morning; at 1.20 dry tornado from E.; evening, N.E.
29. E. morning; thunder, 6 A.M., N.E. to N.; rained, morning; afternoon, N.; evening calm; night, strong S.W.
30. N.W. morning; afternoon, S. Rained heavily at night.
31. N.W. Cloudy morning; fine afternoon.

Sierra Leone region.

In the *second section,* including Sierra Leone, Liberia, Grand Bassam, the Gold Coast, and the Slave Coast (Lagos and other places), we come to the *region of variable winds;* their predominant direction is in opposition to the general course of the trade winds, and, consequently, in a westerly or south-westerly direction. They are subject to frequent changes both in velocity and direction. The movements of these winds are generally in different strata superimposed one upon the other. The land and sea breezes alternate regularly with each other near the shore of this portion of the continent, the sea breeze setting in between ten and half-past twelve in the forenoon and noon, and continuing till between five and seven; between seven and nine the land breeze commences, and continues till between eight and ten. The blowing of the south-west sea breeze from the quarter where the sun has not yet travelled is a merciful providence of the Creator to keep down the intense heat which must be the result of the sun's action on this *zone of calm,* as it cools and moistens the air, and makes it fit for habitation both for vegetable and animal life. "The general temperature between midnight and noon is cooler than the temperature from noon to midnight. Towards sunrise it is a cooler time than any other part of the twenty-four hours; and, taken at equal distances from the meridian over which the sun is passing, the quarters over which the sun has passed are more heated than those towards which it has been longest absent." Winds, then, from parts where the sun has passed, as the north-east wind of the first section, are considerably hotter than those from where it is travelling to, as the south-west, the predominant in this zone; and this explains why the Gambia and Senegal are hotter than Sierra Leone, Liberia, and the Gold Coast, although these places are in the hottest zones.

I have in the second section, under the headings of remarks, detailed the directions of the various winds found on the coast. As the Gold Coast is the centre of this zone, suffice that I here give its prevailing winds in the different

months, as observed by myself,—January, N.E., E.N.E., NW., and W.; February, S.W.—early part, N.E. and E.; March, S. and S.W.; April, W., S., and S.W.; May, S.E., N., N.E., and S.W.; June, S.W. and W.; July, N.W. and W.; August, N.W., W., and S.W.; September, S.W. and N.W.; October, S. and S.W.; November, N.W., W., and S.W.; December, N.W., N.E., E., and S.W. The most prevalent wind, therefore, is from a westerly direction (S.W.); and Freetown being protected in that direction from it by its lofty chain of mountain, stagnation of noxious effluvia, to a certain extent, is the result, and its beneficial influence is lost. The north-east and easterly winds in these regions, blowing just before sunrise, are generally very cool and pleasant.

In the third section, including the Gaboons, a part of Fernando Po, Princes' and St Thomas' Islands, the north-west and south-west winds are generally prevalent; but they are not so constant as in the first section, but variable as in the second. The force and velocity of winds are determined by the anemometer. The following is the result obtained by Mr Smeaton, and confirmed by Mr Hutton :—

Lopez region.

Force of velocity of winds.

Velocity of Winds.		Force on one square foot in pounds avoirdupois.	Character of the Wind.
Miles per Hour.	Feet per Second.		
1	...	...	
2	1·47	·005	Hardly perceptible.
3	2·93	·020	Just perceptible.
4	4·40	·044	
5	5·87	·079	Gentle pleasant wind.
10	7·33	·123	
15	14·67	·492	Pleasant brisk gale.
20	22·00	1·107	
25	29·34	1·968	Very brisk.
30	36·67	3·075	
35	44·01	4·429	High winds.
40	51·34	6·027	
45	58·68	7·873	Very high.
50	66·01	9·963	
55	73·35	12·300	Storm or tempest.
60	88·02	17·1715	Great storm.
80	117·36	31·490	Hurricane.
100	146·70	49·200	Destructive hurricane.

The force of wind is as the square of the velocity by the density. The velocity can be ascertained by taking the square root of 200 times the pressure; the pressure in pounds, or parts of a pound, per square foot, by multiplying the velocity for one hour by 60, and then square the hour velocity, and multiply by ·005.

The velocity of tropical tornadoes, according to Humboldt, is in its extreme at the rate of 200 or 300 miles an hour.

According to Colonel Beaufoy, frequently, in violent storms of wind, the current does not reach any considerable altitude. Often there is perfect calm at the height of 1600 feet. The converse is also true. There are many cases where winds may be noticed at considerable distances above the surface of land or sea, moving with great celerity, whilst the lower strata of the atmosphere is perfectly still and tranquil, as in the account of *Hurricane in the Clouds*, to be hereafter noticed.

Sir H. James, in his "Instruction for Meteorological Observers," gives the following naval terms for expressing the amount of wind. The velocity noted can scarcely be said to be correct:—

	Character of the Wind.	Velocity in miles per hour.	Pressure in lbs. per sq. foot.
0	Calm, ...	...	...
1	Light air, sufficient to give steerage way, .	7	·25
2	Light breeze, ...	14	1
3	Gentle breeze (3 to 4 knots), ...	21	$2\frac{1}{2}$
4	Moderate breeze (5 to 6 knots), ...	28	4
5	Fresh breeze (royals), ...	35	$6\frac{1}{4}$
6	Stormy breeze (single reef and top-gallant sail),	42	9
7	Moderate gale (double reef jib), ...	$49\frac{1}{2}$	$12\frac{1}{4}$
8	Fresh gale (triple reef canvas), ...	56	16
9	Strong gale (close reefs and courses), . .	$63\frac{2}{3}$	$20\frac{1}{4}$
10	Whole gale (close reef main-topsail and reefed foresail), ...	70	25
11	Storm (storm stay-sails), ...	77	$30\frac{1}{4}$
12	Hurricane (no canvas), ...	$84\frac{3}{4}$	36

In October 1860 the following daily observations of the direction of the wind were recorded in the Military Hospital of Freetown:—

DAYS.	Hours of Observation.			DAYS.	Hours of Observation.		
	9 A.M.	3 P.M.	9 P.M.		9 A.M.	3 P.M.	9 P.M.
1	S.E.	S.W.	S.E.	17	N.E.	S.E.	S.W.
2	N.E.	W.	N.E.	18	E.	S.E.	S.W.
3	S.W.	S.	S.	19	W.	S.W.	S.W.
4	N.E.	N.E.	S.W.	20	N.E.	S.	S.W.
5	W.	S.	N.E.	21	E.	E.	S.W.
6	S.E.	N.W.	S.W.	22	N.E.	S.E.	S.W.
7	S.W.	N.W.	S.E.	23	N.W.	E.	S.E.
8	N.W.	S.W.	S.W.	24	E.	S.E.	S.W.
9	N.	W.	N.W.	25	N.E.	W.	N.E.
10	N.W.	W.	S.W.	26	N.E.	W.	S.W.
11	N.E.	W.	S.W.	27	N.E.	N.W.	E.
12	N.E.	N.	S.W.	28	N.W.	N.E.	N.E.
13	N.	S.E.	S.W.	29	...	...	...
14	E.	S.W.	S.W.	30	N.E.	S.W.	S.W.
15	N.W.	N.W.	S.W.	31	N.	N.W.	S.W.
16	N.W.	S.	S.W.				

Humidity and Saturation of the Atmosphere—The Dew-Point.

The amount or degree of atmospheric saturation depends entirely upon the temperature, and increases with it, but faster than the rise of the thermometer. Thus at 32° the air is capable of absorbing 160th part of its weight in aqueous vapours; at 59°, an 80th part; at the temperature of 86°, which is the average heat of the afternoon in the zone of calm, the air absorbs $\frac{1}{40}$th of its weight of aqueous vapours; but when the thermometer goes up to 113° it absorbs a 20th part. At 68° F. a cube of air contains 252 grains of water. In the tropics the annual evaporation exceeds that in the temperate zone by from 63 to 73 inches, being from 90 to 100 inches. Humidity of atmosphere explained.

The point of saturation is the maximum of aqueous vapour capable of being sustained by the atmosphere at the time of observation, any increase of which would lead to a deposit of dew. The temperature of the atmosphere must Point of saturation.

always be above this point, at which dew begins to deposit; if not, the whole surface will be enveloped in perpetual mist, through which the sun's rays can never penetrate. In the tropics the height of humidity is 4½ miles at the equator.

It follows, then, that the greater amount of humidity in Western intertropical Africa is in the regions between Sierra Leone and the equator, and the least in the Gambia and Senegal, since, as the temperature rises in arithmetical progression, the dryness of the air is accelerated in geometrical progression. The effects of humidity, or the absence of it, on the constitution, we shall hereafter consider.

Dew-point. The dew-point, as we have before seen, is that temperature at which the air has its maximum of saturation with moisture, so that the least fall of temperature leads to a deposit of moisture. It is deposited less on hills than plains, the cooling process being more copious in the latter than in the former.

Of the method of finding the humidity and saturation of the air, as well as the dew-point, I must refer my readers to Chapter I.—The Introduction. My observations on these points are unfortunately limited, being confined principally to the Gold Coast and Bights.

Observations. OBSERVATIONS ON THE GOLD COAST AND BIGHT OF BENIN FOR 1859, 1860.

HYGROMETER, SATURATION OF THE ATMOSPHERE, AND DEW-POINT.

January.

Hygrometer.

MAXIMUM OBSERVATIONS.—*Morning*—6th, 11°·15; 5th, 9°·2; 8th, 8°. *Noon*—6th, 14°·2; 4th, 11°·1. *Evening*—5th, 9°·20; 7th, 7°·10.

MEDIUM OBSERVATIONS.—*Morning*—5th, 7°·2. *Noon*—2nd, 9°·10. *Evening*—8th, 6°·12.

MINIMUM OBSERVATIONS.—*Morning*—11th, 2°·50. *Noon*—11th, 4°·50. *Evening*—11th, 3°.

Saturation of the Atmosphere.

MAXIMUM OBSERVATIONS.—*Morning*—3rd, 881°·4; 2nd, 819°. *Noon*—2nd, 743°·7. *Evening*—2nd, 720°·9.

Medium Observations.—*Morning*—17th, 763°·7. *Noon*—21st, 522°·5. *Evening*—6th, 763°·3.

Minimum Observations.—*Morning*, 10th, 578°·1. *Noon*—15th, 472°. *Evening*—25th, 722°·7.

Dew-Point.

Maximum Observations.—*Morning*—3rd, 74°; 1st, 12th, and 24th, 73°. *Noon*—2nd, 10th, and 12th, 74°. *Evening*—2nd and 20th, 74°.

Medium Observations.—*Morning*—5th, 12th, and 18th, 68°. *Noon*—4th, 7th, and 30th, 65°. *Evening*—6th, 16th, and 27th, 68°.

Minimum Observations.—*Morning*—6th, 60°. *Noon*—5th, 57°. *Evening*—5th, 66°.

February.

Hygrometer.

Maximum Observations.—*Morning*—13th, 7°·3; 6th, 7°; 5th, 20th, and 27th, 6°·14. *Noon*—16th, 9°·10; 5th and 7th, 8°·2. *Evening*—2nd, 23rd, and 24th, 9°·15; 20th and 27th, 6°.

Medium Observations.—*Morning*—3rd and 8th, 5°. *Noon*—10th, 18th, and 25th, 7°·10. *Evening*—19th and 27th, 6°.

Minimum Observations.—*Morning*—2nd and 10th, 3°·2. *Noon*—17th and 26th, 5°. *Evening*—6th and 8th, 3°·30.

Saturation of the Atmosphere.

Maximum Observations.—*Morning*—13th, 906°·6; 1st, 4th, 6th, and 11th, 877°·6; 21st, 877°·8. *Noon*—6th, 9th, 18th, and 25th, 879°·8. *Evening*—2nd, 19th, and 28th, 822°·1.

Medium Observations.—*Morning*—4th and 19th, 848°·7. *Noon*—16th and 23rd, 724°·5. *Evening*—5th, 8th, and 17th, 804°·9.

Minimum Observations.—*Morning*—2nd and 20th, 694°·7. *Noon*—7th and 10th, 722°·9. *Evening*—18th, 24th, and 26th, 771°·1.

Dew-Point.

Maximum Observations.—*Morning*—5th, 6th, 18th, and 20th, 78°. *Noon*—6th and 15th, 79°. *Evening*—10th and 29th, 80°.

Medium Observations.—*Morning*—5th, 7th, 16th, and 25th, 75°. *Noon*—1st, 2nd, and 18th, 77°. *Evening*—9th, 12th, and 18th, 78°.

Minimum Observations.—*Morning*—16th and 17th, 73°. *Noon*—23rd and 24th, 72°. *Evening*—14th, 16th, and 27th, 69°.

March.

Hygrometer.

Maximum Observations.—*Morning*—10th and 28th, 10°. *Evening*—28th, 9°·2; 10th, 12th, 27th, and 30th, 8°.

Medium Observations.—*Morning*—12th, 25th, 27th, and 29th, 5°. *Noon*—13th, 15th, 19th, 20th, and 31st, 9°. *Evening*—14th, 22nd, and 31st, 7°.

Minimum Observations.—*Morning*—22nd, 3°. *Noon*—14th, 5°·40. *Evening*—31st, 81°.

Saturation of the Atmosphere.

Maximum Observations.—*Morning*—18th, 20th, and 26th, 963°·9. *Noon*—12th, 849°·6; 21st, 822°·1. *Evening*—21st, 963°·9; 24th, 877°·5; 19th, 823°·4; 17th, 822°·1.

Medium Observations.—*Morning*—19th and 24th, 848°·7. *Noon*—9th, 16th, and 30th, 772°·0. *Evening*—23rd, 804°·9.

Minimum Observations.—*Morning*—22nd, 743°·7. *Noon*—12th, 612°. *Evening*—26th, 721°.

Dew-Point.

Maximum Observations.—*Morning*—18th, 20th, 22nd, and 26th, 80°. *Noon*—16th, 19th, 20th, 22nd, 26th, and 27th, 80°. *Evening*—18th and 21st, 80°.

Medium Observations.—*Morning*—7th, 8th, 13th, 22nd, and 30th, 78°. *Noon*—31st, 77°. *Evening*—15th and 28th, 77°.

Minimum Observations.—*Morning*—23rd, 74°. *Noon*—12th, 72°. *Evening*—13th and 26th, 74°.

April.

Hygrometer.

Maximum Observations.—*Morning*—24th, 7°. *Noon*—13th and 24th, 9°; 3rd, 8°·30; 17th, 8°·20; 2nd, 6th, 7th, 9th, 11th, 12th, 15th, 16th, 18th, and 27th, 8°. *Evening*—24th, 8°; 2nd, 3rd, 18th, and 20th, 7°.

Medium Observations.—*Morning*—10th, 14th, and 22nd, 5°. *Noon*—10th, 14th, 25th, 26th, and 29th, 7°. *Evening*—5th, 7th, 11th, 15th, 23rd, and 27th, 6°.

Minimum Observations.—*Morning*—25th and 26th, 2°. *Noon*—21st, 3°. *Evening*—20th, 25th, and 30th, 4°.

Saturation of the Atmosphere.

Maximum Observations.—*Morning*—13th and 15th, 963°·9; 25th and 26th, 936°·5; 18th, 19th, 20th, 27th, and 30th, 906°·2;

29th, 906°. *Noon*—21st, 881°·4; 30th, 849°·6. *Evening*—25th, 963°·9; 28th, 877°·6.

MEDIUM OBSERVATIONS.—*Morning*—2nd, 3rd, 10th, 12th, 14th, and 21st, 877°·6. *Noon*—10th, 14th, and 25th, 797°·8. *Evening*—14th, 796°·8.

MINIMUM OBSERVATIONS.—*Morning*—24th, 716°·2. *Noon*—13th, 724°·5. *Evening*—6th and 24th, 697°·8.

Dew-Point.

MAXIMUM OBSERVATIONS.—*Morning*—13th and 15th, 80°. *Noon*—14th, 80°·15: *Evening*—13th, 80°·45.

MEDIUM OBSERVATIONS.—*Morning*—10th and 22nd, 76°. *Noon*—2nd, 19th, 22nd, 26th, 27th, and 29th, 78°. *Evening*—16th, 77°.

MINIMUM OBSERVATIONS.—*Morning*—23rd and 24th, 70°. *Noon*—22nd, 74°. *Evening*—6th and 24th, 75°.

May.

Hygrometer.

MAXIMUM OBSERVATIONS.—*Morning*—10th, 5°; 1st, 2nd, 5th, 11th, 12th, 14th, 17th, 22nd, 23rd, and 30th, 4°. *Noon*—18th, 19th, and 22nd, 9°; 6th and 21st, 8°. *Evening*—18th, 9°; 22nd, 8°; 12th, 7°·45.

MEDIUM OBSERVATIONS.—*Morning*—24th, 3°·25. *Noon*—8th, 7°·50; 12th, 7°·6; 11th, 13th, 23rd, and 27th, 7°. *Evening*—1st, 2nd, 4th, 6th, 8th, 11th, 13th, 21st, and 30th, 5°.

MINIMUM OBSERVATIONS.—*Morning*—20th, 1°. *Noon*—5th, 6th, 14th, 17th, 20th, and 31st, 4°. *Evening*—27th and 31st, 3°.

Saturation of the Atmosphere.

MAXIMUM OBSERVATIONS.—*Morning*—25th, 978°; 27th, 906°·2; 20th and 28th, 935°·2. *Noon*—2nd, 3rd, 5th, 6th, 9th, 11th, and 31st, 877°·6; 7th, 26th, and 29th, 822°·1. *Evening*—27th and 29th, 906°; 1st, 3rd, 7th, 8th, and 11th, 877°; 31st, 876°·7.

MEDIUM OBSERVATIONS.—*Morning*—13th and 16th, 881°·4. *Noon*—21st, 721°. *Evening*—4th and 30th, 793°·6.

MINIMUM OBSERVATIONS.—*Morning*—2nd and 10th, 792°. *Noon*—18th and 22nd, 675°·2. *Evening*—18th, 695°·8.

Dew-Point.

MAXIMUM OBSERVATIONS.—*Morning*—4th, 78°; 6th, 77°·50; 22nd, 77°. *Noon*—10th, 78°·50; 2nd, 3rd, 5th, 6th, 8th, 9th, 11th, 20th, 28th, 29th, and 31st, 78°. *Evening*—1st, 3rd, 7th, 8th, and 11th, 78°; 6th, 77°·18; 20th, 77°.

Medium Observations.—*Morning*—17th, 18th, and 26th, 75°. *Noon*—6th, 15th, 16th, 24th, and 30th, 76°. *Evening*—5th and 16th, 40°.

Minimum Observations.—*Morning*—10th, 14th, and 17th, 71°. *Noon*—14th, 17th, 18th, 20th, 21st, 22nd, 23rd, 25th, and 27th, 74°. *Evening*—18th and 22nd, 73°.

June.

Hygrometer.

Maximum Observations.—*Morning*—28th, 5°; 17th and 18th, 4°. *Noon*—21st, 24th, and 30th, 7°·15; 16th, 17th, 20th, 22nd, and 23rd, 7°. *Evening*—18th, 19th, 21st, and 28th, 6°; 27th, 5°·30; 24th, 5°·23; 2nd, 5°·40.

Medium Observations.—*Morning*—22nd, 3°·20. *Noon*—26th, 6°·45. *Evening*—23rd, 4°.

Minimum Observations.—*Morning*—18th, 21st, and 27th, 71°. *Noon*—21st, 70°·45. *Evening*—18th, 70°.

Saturation of the Atmosphere.

Maximum Observations.—*Morning*—1st, 967°·6; 25th, 935°·2; 19th, 26th, 29th, and 30th, 934°·8. *Noon*—29th, 904°·9. *Evening*—28th, 874°·9.

Medium Observations.—*Morning*—2nd and 24th, 881°·4. *Noon*—16th, 793°·7. *Evening*—23rd, 819°·2.

Minimum Observations.—*Morning*—26th, 767°·1. *Noon*—21st, 693°·1. *Evening*—21st and 29th, 727°·7.

Dew-Point.

Maximum Observations.—*Morning*—4th, 77°. *Noon*—2nd, 78°. *Evening*—20th, 76°; 24th, 75°·3.

Medium Observations.—*Morning*—17th, 73°. *Noon*—17th and 19th, 75°. *Evening*—17th, 73°·40; 16th, 25th, and 30th, 73°.

Minimum Observations.—*Morning*—18th, 21st, and 27th, 71°. *Noon*—21st, 70°·45. *Evening*—18th, 70°.

July.

Hygrometer.

Maximum Observations.—*Morning*—25th, 4°·30; 9th, 12th, 15th, 26th, 27th, and 28th, 4°; 6th, 3°·30; 5th, 3°·25. *Noon*—4th, 8th, and 10th, 9°; 19th, 8°·30; 27th, 8°. *Evening*—10th, 16th, and 19th, 7°; 23rd, 6°.

Medium Observations.—*Morning*—8th, 2°·40; 16th and 31st, 2°·30. *Noon*—7th, 6°·20. *Evening*—9th and 10th, 5°·35; 6th and 8th, 5°·30.

Minimum Observations.—*Morning*—1st and 2nd, 1°. *Noon*—22nd, 3°. *Evening*—3rd and 15th, 3°.

Saturation of the Atmosphere.

Maximum Observations.—*Morning*—2nd, 978°; 1st, 966°·5; 3rd, 936°·3; 18th, 20th, 24th, and 31st, 935°·2. *Noon*—22nd, 881°·4; 1st, 3rd, 14th, and 16th, 820°·9. *Evening*—28th, 904°·9; 15th, 881°·4; 3rd, 876°·4.

Medium Observations.—*Morning*—14th and 30th, 874°·9. *Noon*—12th, 15th, 21st, and 28th, 767°·7. *Evening*—13th, 21st, and 24th, 819°·2.

Minimum Observations.—*Morning*—9th, 767°·1. *Noon*—10th, 670°·9. *Evening*—6th and 8th, 719°·8.

Dew-Point.

Maximum Observations.—*Morning*—3rd, 75°; 2nd, 18th, 20th, 21st, and 24th, 74°; 1st, 2nd, 3rd, 14th, 16th, and 22nd, 74°. *Evening*—3rd and 15th, 74°.

Medium Observations.—*Morning*—8th, 73°·20. *Noon*—4th, 5th, 7th, 8th, 12th, 15th, 17th, 21st, 28th, and 29th, 72°. *Evening*—2nd, 4th, 17th, 22nd, 24th, 25th, and 29th, 73°.

Minimum Observations.—*Morning*—7th, 11th, and 27th, 71°. *Noon*—10th and 27th, 70°. *Evening*—10th and 16th, 70°.

August.

Hygrometer.

Maximum Observations.—*Morning*—4th and 10th, 3°. *Noon*—1st, 8°; 12th, 7°. *Evening*—2nd, 20th, and 28th, 5°.

Medium Observations.—*Morning*—14th, 22nd, and 31st, 2°·30. *Noon*—3rd, 16th, 20th, and 26th, 6°·10. *Evening*—7th, 21st, and 30th, 3°.

Minimum Observations.—*Morning*—3rd, 29th, and 30th, 2°. *Noon*—29th, 3°. *Evening*—31st, 1°.

Saturation of the Atmosphere.

Maximum Observations.—*Morning*—5th, 934°·8; 29th, 934°·2. *Noon*—20th, 26th, and 29th, 873°·5. *Evening*—12th, 14th, and 29th, 967°·6; 30th, 934°·8.

Medium Observations.—*Morning*—2nd, 18th, and 30th, 891°·3. *Noon*—4th, 10th, and 21st, 743°·7. *Evening*—6th and 15th, 822°·4.

Minimum Observations.—*Morning*—6th, 874°·9. *Noon*—1st, 695°·6. *Evening*—1st, 764°·5.

Dew-Point.

Maximum Observations.—*Morning*—7th and 29th, 72°·40. *Noon*—2nd, 9th, and 20th, 74°. *Evening*—23rd and 30th, 72°·30.

Medium Observations.—*Morning*—5th, 72°. *Noon*—12th and 17th, 72°. *Evening*—4th, 8th, and 25th, 71°.

Minimum Observations.—*Morning*—30th, 70°. *Noon*—29th, 70°. *Evening*—2nd, 70°.

September.

Hygrometer.

Maximum Observations.—*Morning*—8th, 4°; 6th, 3°·10. *Noon*—7th and 25th, 6°; 5th, 5°·30; 6th, 11th, 14th, and 15th, 5°. *Evening*—4th, 4°; 1st, 2nd, 5th, 6th, 7th, 11th, 13th, 14th, 15th, 17th, and 23rd, 3°.

Medium Observations.—*Morning*—1st, 7th, 9th, 10th, 11th, 13th, 16th, 18th, 24th, 26th, and 28th, 3°. *Noon*—26th, 4°·30. *Evening*—12th, 18th, and 28th, 2°.

Minimum Observations.—*Morning*—3rd, 4th, 5th, 12th, 14th, 15th, 17th, 27th, and 29th, 2°. *Noon*—4th, 2°. *Evening*—3rd, 1°.

Saturation of the Atmosphere.

Maximum Observations.—*Morning*—4th, 5th, and 14th, 935°·8; 27th, 934°·2. *Noon*—4th, 934°·8; 19th, 874°·9. *Evening*—3rd, 966°·5; 12th and 18th, 935°·8.

Medium Observations.—*Morning*—28th, 901°·8. *Noon*—1st, 2nd, 13th, and 16th, 822°·4. *Evening*—23rd and 26th, 874°·9.

Minimum Observations.—*Morning*—11th, 844°·2. *Noon*—25th, 740°·1. *Evening*—4th, 822°·4.

Dew-Point.

Maximum Observations.—*Morning*—27th and 30th, 73°; 28th, 72°. *Noon*—23rd, 27th, and 28th, 73°; 14th, 15th, 19th, and 30th, 72°. *Evening*—3rd, 73°; 30th, 74°.

Medium Observations.—*Morning*—5th, 23rd, 24th, and 26th, 71°. *Noon*—26th, 71°·30. *Evening*—1st, 2nd, 6th, 8th, 12th, 15th, 16th, and 18th, 71°.

Minimum Observations.—*Morning*—8th, 68°. *Noon*—9th, 68°. *Evening*—14th, 68°.

October.

Hygrometer.

MAXIMUM OBSERVATIONS.—*Morning*—17th and 31st, 5°; 18th and 27th, 4°. *Noon*—8th and 9th, 8°; 26th and 30th, 6°. *Evening*—8th, 6°.

MEDIUM OBSERVATIONS.—*Morning*—4th, 6th, 7th, 19th, 25th, 26th, and 28th, 3°. *Noon*—15th, 16th, 18th, 25th, and 27th, 5°; 2nd, 7th, and 10th, 4°. *Evening*—1st, 5th, 6th, 17th, 25th, and 30th, 3°.

MINIMUM OBSERVATIONS.—*Morning*—1st, 2nd, 5th, 9th, 16th, 24th, 30th, 2°. *Noon*—3rd, 2°. *Evening*—18th, 1°·50.

Saturation of the Atmosphere.

MAXIMUM OBSERVATIONS.—*Morning*—10th, 16th, and 24th, 936°·2; 1st, 2nd, 5th, and 9th, 935°·2; 3rd, 934°·2. *Noon*—3rd, 935°·2; 4th and 6th, 881°·4; 24th, 876°·7; 1st and 5th, 876°·4. *Evening*—24th, 957°·9; 21st, 936°·2; 2nd, 4th, 8th, and 10th, 935°·2.

MEDIUM OBSERVATIONS.—*Morning*—21st, 25th, and 28th, 881°·4. *Noon*—15th, 16th, 17th, and 25th, 793°·6. *Evening*—5th, 904°·9.

MINIMUM OBSERVATIONS.—*Morning*—18th, 767°·1. *Noon*—8th, 691°·5. *Evening*—7th, 765°·4.

Dew-Point.

MAXIMUM OBSERVATIONS.—*Morning*—16th, 76°; 30th, 75°. *Noon*—24th, 76°; 1st, 5th, 19th, 25th, and 27th, 75°; 3rd, 4th, 6th, 7th, 15th, 16th, 18th, and 26th, 74°. *Evening*—24th and 25th, 75°; 4th, 7th, 9th, 16th, 25th, and 30th, 74°.

MEDIUM OBSERVATIONS.—*Morning*—10th, 74°·50. *Noon*—2nd, 72°·30. *Evening*—1st, 3rd, 5th, and 6th, 73°.

MINIMUM OBSERVATIONS.—*Morning*—4th and 6th, 71°. *Noon*—8th, 68°. *Evening*—8th, 69°.

November.

Hygrometer.

MAXIMUM OBSERVATIONS.—*Morning*—27th, 6°·2; 14th and 28th, 5°. *Noon*—16th, 7°·58; 9th, 7°·10. *Evening*—9th, 5°·30.

MEDIUM OBSERVATIONS.—*Morning*—12th and 21st, 4°. *Noon*—15th and 24th, 6°·10. *Evening*—14th and 24th, 4°.

MINIMUM OBSERVATIONS.—*Morning*—15th and 29th, 3°; 16th, 17th, 18th, 19th, 20th, and 23rd, 3°·25. *Noon*—13th, 4°·40. *Evening*—17th, 3°·10.

Saturation of the Atmosphere.

MAXIMUM OBSERVATIONS.—*Morning*—15th, 881°·4; 15th, 17th, 18th, 19th, 20th, and 24th, 876°·4. *Noon*—13th, 848°·7; 17th, 822°·1. *Evening*—17th, 876°·7.

MEDIUM OBSERVATIONS.—*Morning*—21st, 820°·9. *Noon*—27th, 743°·7. *Evening*—16th, 694°·7.

MINIMUM OBSERVATIONS.—*Morning*—27th, 766°·5. *Noon*—16th, 670°·9. *Evening*—9th, 792°.

Dew-Point.

MAXIMUM OBSERVATIONS.—*Morning*—18th and 20th, 76°; 17th, 19th, and 24th, 75°. *Noon*—13th and 17th, 78°. *Evening*—17th and 24th, 76°.

MEDIUM OBSERVATIONS.—*Morning*—21st, 74°. *Noon*—23rd, 75°. *Evening*—16th, 74°.

MINIMUM OBSERVATIONS.—*Morning*—27th and 28th, 70°. *Noon*—16th, 72°. *Evening*—9th, 72°.

December.

Hygrometer.

MAXIMUM OBSERVATIONS.—*Morning*—14th, 5°·25; 5th and 6th, 5°. *Noon*—6th, 7°·15; 1st, 8th, and 11th, 6°·10. *Evening*—11th, 5°·30; 2nd and 5th, 5°·25.

MEDIUM OBSERVATIONS.—*Morning*—3rd and 7th, 4°. *Noon*—1st, 8th, and 11th, 6°. *Evening*—16th and 17th, 5°.

MINIMUM OBSERVATIONS.—*Morning*—2nd, 2°·25. *Noon*—4th, 4°·5. *Evening*—15th, 4°·41.

Saturation of the Atmosphere.

MAXIMUM OBSERVATIONS.—*Morning*—8th, 936°·2. *Noon*—4th, 793°·6. *Evening*—11th, 821°·6.

MEDIUM OBSERVATIONS.—*Morning*—4th, 819°. *Noon*—11th, 760°·9. *Evening*—16th and 17th, 821°·6.

MINIMUM OBSERVATIONS.—*Morning*—6th, 727°·7; 8th, 790°·4. *Evening*—11th, 795°.

Dew-Point.

MAXIMUM OBSERVATIONS.—*Morning*—7th and 11th, 74°. *Noon*—6th, 74°. *Evening*—15th, 78°.

MEDIUM OBSERVATIONS.—*Morning*—4th, 73°. *Noon*—4th and 7th, 74°. *Evening*—5th, 16th, and 17th, 77°.

MINIMUM OBSERVATIONS.—*Morning*—1st and 3rd, 73°. *Noon*—1st, 74°. *Evening*—11th, 76°.

In August 1860, the following was the Dew-Point registered in the Military Hospital, Sierra Leone:—

DAYS.	9 A.M.	9 P.M.	DAYS.	9 A.M.	9 P.M.
1	71·25	...	17	73·9	67·1
2	72·12	...	18	69·5	73·8
3	73·25	71·9	19	73·95	70·15
4	68·9	69·3	20	66·8	67·4
5	70·9	69·2	21	71·5	69·2
6	71·9	68·1	22	72·25	71·75
7	70·5	70·5	23	72·6	68·8
8	71·6	69·2	24	70·5	67·25
9	69·5	70·9	25	68·9	66·25
10	71·95	70·5	26	69·7	69·2
11	70·2	70·5	27	70·5	68·95
12	72·25	71·6	28	68·1	67·1
13	72·6	70·15	29	69·0	67·1
14	69·8	67·25	30	69·95	68·1
15	67·4	66·8	31	69·65	68·8
16	71·75	71·5			

Register of Dew-Point in the Military Hospital, Bathurst, River Gambia, for 1866.

MONTHS.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Jan.	70·1	65·43	66·76	68·8	62·96	61·33	59·26	60·96	63·10	58	64·7	66·66	61·63	56·99	58·64	63·77
Feb.	57·8	56·9	51·3	59·3	61·0	58·2	57·9	58·0	52·1	53·4	57	64·2	64·4	64	63·2	65·3
March,	59·2	60·6	59·9	58·5	56·2	55·9	60·6	58·8	57	57·7	58·2	62·2	66·5	57·5	55·2	55·7
April,	62·6	62·9	61·6	61·3	63·4	63·7	63·3	65·3	66·2	68·3	64·2	66·1	63·9	58·3	64·5	57·1
May,	59·1	59	59·3	56·7	61·2	58·6	59·8	56	58·8	58·3	59·5	60·5	61·9	57·8	59·7	61·3
June,	57·4	63·6	61·2	59·2	64·3	60·1	60·5	62·1	58·6	61	58	61·4	59·5	59·1	59·4	60·9
July,	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Aug.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sept.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Oct.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nov.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dec.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

REGISTER OF DEW-POINT—*continued.*

MONTHS.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Jan.	58·83	67·2	67·8	62·1	66·6	66·83	67·93	68·66	69·48	59·66	62·76	63·48	62·8	60·63	68·66
Feb.	62·7	63·3	68·7	62·6	62·9	68·5	63·5	65·0	63·6	66·7	67·7	67·6	...	...	...
March,	57	56·2	54·7	59·8	58·1	56·2	56·3	53·7	54	53·6	55·5	55·3	52·8	52·2	50·8
April,	53·5	58·4	53·5	62·6	65·2	63·6	64·6	64·2	61·7	65·7	71·3	68·8	63·1	58·2	...
May,	61·5	60·5	60·8	60·5	58·7	63·1	60·1	61	59·4	62·7	61·1	64·3	61·3	64·5	62·2
June,	59	58·5	59·5	67	71·4	67·5	66·1	74·5	65·7	63·1	64·1	62·8	61·3	61·7	...
July,	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Aug.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sept.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Oct.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nov.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dec.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

CHAPTER VIII.

BAROMETRIC PRESSURE—OZONOMETER—AMOUNT OF CLOUD—NOTATION OF THE WEATHER.

In 1646, through the independent researches of Pascal and Torricelli, it was ascertained that a column of water 34 feet high, and a column of mercury 30 inches high, each exactly counterpoises a column of air of an equal base, extending from the level of the sea to the summit of the atmosphere; and the next year the former observer discovered that there exists a distinct and constant relation between the rise and fall of the mercury in the Torricelli instrument and the changes in the temperature of the atmosphere, produced by rarefaction or condensation, by elevation or descent, each of which is dependent on the unequal distribution of heat. Barometer, principle of.

My observations on the barometric pressure in Western Africa are, unfortunately, very limited, but it appears that the *maximum* height of the barometer takes place during the blowing of the harmattan winds, and consequently from December to February; and the *minimum* during the tornado periods, at the beginning and after the rains. The barometer always falls at the approach of rain or wind, and begins to rise during it. The cold, dry, dense air of the harmattan raises the barometric column, whilst the rarefaction of the air preceding the tornado storm depresses it. The greatest range of the barometer in the Gambia, Senegal, and Casamanza, occurs in the month of January; in Sierra Leone in April or May; on Period of maximum and minimum observations.

the Gold Coast and Lagos in September; the least range in the first named places, in March, April, and May; in the second and third places, in February.

It has been ascertained that for every inch which the mercury in the barometer rises or falls, the boiling point of water is increased or diminished by 1°·76; therefore, if the barometer rises or falls one-tenth of an inch, there is an elevation or depression of the boiling point by 0°·176 F. Mr Fahrenheit took advantage of this to ascertain the height of mountains, and "he proposed, that in order to find the difference in feet between the upper and lower stations, pure water should be boiled in an open vessel at both stations, and the difference of temperature at which it boils should be multiplied by 5·30, which will give a close approximation to the height of the upper above the lower station. From the conjoined temperatures of the atmosphere at the stations, 64° are to be subtracted, and the remainder is to be multiplied by the one-thousandth part of the height already found, to which it is to be added. This is the correction for the difference of the temperature at the stations. A further correction is necessary for the figure of the earth and the latitude of the place."* This, on the West Coast of Africa, amounts to about one foot in addition to every thousand of the calculated elevation.

Barometer in measuring mountains.

As an example, let us imagine water to boil at the level of the sea opposite Freetown at 212° F., and at a height by the side of Sugar-Loaf Mountain at 210°. The temperature at the sea level being 84°, and that at the higher station 80°, the actual height is thus found,—

Temperature of water, 212° − 210° = 2 × 530 = 1060 = approximate height.

Temperature of atmosphere, 84° + 80° = 164 − 64 = 100 × 1·060 = 100 + 1060 = 2060.

Latitude, 2·060 × 1 = 2·060 + 2060 = 2062·06. The actual height of the spot examined.

Lately a sensitive and very accurate barometer was invented

* Pickford's Hygiene, p. 13.

by M. Vidi, a native of France, which is called the "*Aneroid Barometer.*"* It "consists of a flat circular metallic box, 4¾ inches in diameter, and 1¾ inch thick." Within is an exhausted copper drum, having a thin corrugated upper plate or head. From the centre of this last an upright metallic shaft springs, "which, as it rises or falls by the varying amount of atmospheric pressure exercised on the drumhead," multiplies, through ingenious and complicated springs and levers attached to its upper end, "the delicate movements thus propagated to it;" these are marked by an index which traverses a graduated dial, corresponding in inches and tenths with the scale of the mercurial barometer. I have given a few observations taken with this instrument in the Military Hospital at Sierra Leone. "Aneroid barometer," description and uses of.

A column of air, extending from the surface of the sea to the top of the atmosphere, which is equal to about 45 to 50 miles, exercises a pressure upon one inch of surface, of 15 lbs., or more correctly, 14·75 lbs.; and according to Professor Schmid of Jena, the entire weight of the atmosphere on the whole surface of the earth is 612,489,851,187,053 tons. An average-sized man exhibits a surface of 15 square feet, or 2160 square inches, and therefore at the level of the sea sustains a total atmospheric pressure, equal in all directions, of 32,400 lbs., or nearly 14½ tons.

The barometer presents steady diurnal changes, depending on the amount of aqueous vapours. There are two maxima, viz., one at about 9 A.M., and the other at about 10 P.M.; and two minima, one between 3 and 4 P.M., and the other at about 4 A.M.

For the rules necessary to be observed in the use of the barometer as a weather glass, see the introductory chapter.

At present all the stations of the British, Dutch, and Spanish Governments on the West Coast of Africa are more or less confined to the sea coast. The French Government has most of its stations on the sea coast, and a few in the interior. These stations are well supplied with ozone from their posi- Ozone in Western Africa.

* Ἄνευ, *without*, and ῥοώδης, *fluid*.

tions, ozone being abundantly generated from the surface of the sea; it is the most powerful oxidising agent yet known, and it has a powerful affinity for malarious or paludal poisons, which it rapidly decomposes; it is more plentiful at night, when malaria is very rife, than in the day, when it is less so.

It is a natural ingredient of atmospheric air, and consists of three equivalents or atoms of oxygen and one of hydrogen. According to Schönbein, it is one of the "chemical antipodes and antidotes to all oxidable miasmatic and malarious gases and emanations disengaged from putrefying animal and vegetable substances, converting them into innocuous matter, and thus purifying and sustaining the entire salubrity of the atmosphere. In short, so hostile to organic miasmata, so incompatible with them is ozone, that the presence of the latter enables us to affirm the absence of the former, and the healthiness of the locality in which it is found." The observations in Freetown show the existence of but small quantities of ozone. This must be due to its destruction by miasmatic agencies which it decomposed; and since vegetation and the foliage of trees generates a large quantity, the Sierra Leone Government should take advantage of this, and plant trees in the streets of Freetown.

In another place I shall fully consider the effects of ozone in the atmosphere in the treatment of malarious fevers. There has been no ozonometric observations made in the Gambia, and I have not heard of any in Senegal.

Clouds, uses and causes of their colour.

I have in the introduction stated that clouds are visible collections of minute globules of water in suspension in the atmosphere. They are useful in moderating the temperature on the surface of the earth, preventing vegetation from being scorched by day, and radiation of the earth's heat at night, and consequently opposed to the deposit of dew. Through the clouds the evaporation which is continually taking place on the surface of oceans, seas, and rivers, is carried through the agency of the wind into the interior of continents in the form of rain.

The beautiful cerulean colour of the sky, and the variegated

tints which the clouds assume during the setting of the sun in the beginning and latter end of the rains, and which is so well marked in intertropical Western Africa, are produced by the reflection, refraction, and decomposition of the light of the sun by the aqueous vapour of the atmosphere.

Observations on the Gold Coast, Bights of Benin, and Sierra Leone, for 1859, 1860.

BAROMETER, OZONOMETER, AMOUNT OF CLOUD, AND NOTATION OF WEATHER.

January.

Barometer.

Maximum Observations.—*Morning*—7th, 30°·98; 8th, 31°. *Noon*—7th, 30°·98; 8th, 31°. *Evening*—7th, 30°·98; 8th, 31°.

Medium Observations.—*Morning*—6th, 30°·90. *Noon*—6th and 10th, 30°·87. *Evening*—5th, 30°·80.

Minimum Observations.—*Morning*—13th, 30°·72. *Noon*—2nd and 4th, 30°·74. *Evening*—4th and 12th, 30°·72.

Weather.

Wet—Day, 1; night, 1. *Fair*—Days, 27; nights, 27. *Cloudy*—Days, 3; nights, 3.

February.

Weather.

Wet—Days, 2; night, 1. *Fair*—Days, 20; nights, 22. *Cloudy*—Days, 7; nights, 6.

March.

Amount of Cloud.

Maximum Observations.—*Morning*—21st, 1° S.W. by S. *Noon*—17th, 5° zenith S. to N.W. *Evening*—15th, 10° W. and S.W.

Medium Observations.—*Morning*—13th, 17th, 23rd, and 26th, 0°·8. *Noon*—12th and 13th, 2°. *Evening*—15th, 1°.

Minimum Observations.—*Morning*—16th, 0°·2 W. *Noon*—22nd, 0°·3 S.W. *Evening*—22nd, 0°·2 S.

Ozonometer.

Day Observations.—*Maximum*—25th, 9°. *Medium*—23rd and 24th, 6°. *Minimum*—23rd, 1°.

Night Observations.—*Maximum*—28th, 10°. *Medium*—23rd, 25th, and 30th, 8°·1. *Minimum*—22nd, 4°.

Weather.

Wet—Days, 3; nights, 2. *Fair*—Days, 13; nights, 16. *Cloudy*—Days, 15; nights, 13.

April.

Amount of Cloud.

MAXIMUM OBSERVATIONS.—*Morning*—23rd, 7°·3. *Noon*—21st, 10°. *Evening*—5th, 8°·2; 6th, 10°.

MEDIUM OBSERVATIONS.—*Morning*—5th, 8th, 18th, 20th, 25th, and 29th, 2°. *Noon*—5th and 23rd, 6°·3. *Evening*—5th and 28th, 6°·4.

MINIMUM OBSERVATIONS.—*Morning*—11th and 17th, 0°·5. *Noon*—25th, 0°·7. *Evening*—2nd, 0°·8.

Ozonometer.

DAY OBSERVATIONS.—*Maximum*—2nd, 8°·2. *Medium*—4th, 7°·1. *Minimum*—6th, 13th, and 22nd, 1°.

NIGHT OBSERVATIONS.—*Maximum*—28th, 9°·4. *Medium*—1st and 25th, 7°·3. *Minimum*—17th and 22nd, 1°·5.

Weather.

Wet—Days, 4; nights, 4. *Fair*—Days, 17; nights, 15. *Cloudy*—Days, 9; nights, 11.

May.

Amount of Cloud.

MAXIMUM OBSERVATIONS.—*Morning*—2nd, 14th, and 31st, 10°; 4th, 22nd, and 24th, 8°·2. *Noon*—9th and 27th, 10°; 25th, 9°·1. *Evening*—1st and 22nd, 10°; 9th and 30th, 8°·2.

MEDIUM OBSERVATIONS.—*Morning*—30th, 7°·4. *Noon*—7th and 21st, 5°. *Evening*—3rd and 29th, 6°·4.

MINIMUM OBSERVATIONS.—*Morning*—16th, 0°·2. *Noon*—16th, 0°·5. *Evening*—18th, 0°·5.

Ozonometer.

DAY OBSERVATIONS.—*Maximum*—4th, 7°·3; 2nd and 31st, 5°. *Medium*—5th, 23rd, and 30th, 2°. *Minimum*—6th and 16th, 0°·2.

NIGHT OBSERVATIONS.—*Maximum*—1st and 30th, 8°·2; 2nd, 3rd, and 4th, 7°; 31st, 6°·4. *Medium*—14th and 20th, 6°; 5th, 5°. *Minimum*—26th, 0°·1.

Weather.

Wet—Days, 3; nights, 7. *Fair*—Days, 21; nights, 17. *Cloudy*—Days, 8; nights, 14.

June.

Amount of Cloud.

MAXIMUM OBSERVATIONS.—*Morning*—17th, 19th, and 20th, 10°, all directions. *Noon*—17th, 10° E.N.E. to S.W.; 22nd, 10° N. to E.N.E.; 28th, 10°, all directions. *Evening*—18th, 27th, and 28th, 10°, all directions.

MEDIUM OBSERVATIONS.—*Morning*—22nd, 6° S.S.W. to N.N.W. *Noon*—18th and 19th, 7°; 27th, N.E. and W.S.W. *Evening*—16th, 5° N. to W.

MINIMUM OBSERVATIONS.—*Morning*—20th, 1° E. *Noon*—7th, 0°·5, scattered. *Evening*—20th, 0°·2, scattered.

Ozonometer.

DAY OBSERVATIONS.—*Maximum*—19th, 9°; 18th, 8°; 26th, 6°·4; 27th, 6°. *Medium*—21st, 5°; 1st, 2nd, 20th, and 28th, 4°. *Minimum*—30th, 0°·5.

NIGHT OBSERVATIONS.—*Maximum*—18th, 8°; 26th and 27th, 7°; 16th and 17th, 6°·4. *Medium*—24th and 21st, 5°; 1st and 23rd, 3°. *Minimum*—29th and 30th, 0°·8.

Weather.

Wet—Days, 4; nights, 5. *Fair*—Days, 15; nights, 13. *Cloudy*—Days, 11; nights, 12.

July.

Amount of Cloud.

MAXIMUM OBSERVATIONS.—*Morning*—1st, 12th, 15th, 16th, 27th, and 31st, 10°, in all directions; 4th, 10° N.E., W. to S.S.W. *Noon*—1st, 6th, 7th, 29th, 30th, and 31st, 10°, all directions. *Evening*—5th, 6th, 12th, and 29th, 10°, all directions.

MEDIUM OBSERVATIONS.—*Morning*—25th, 6° zenith. *Noon*—15th and 27th, 64° N. and S.W. *Evening*—16th, 6° S.W. to N.E.

MINIMUM OBSERVATIONS.—*Morning*—10th, 1° N. to N.W. *Noon*—8th and 24th, 2°. *Evening*—11th, 0°·1.

Ozonometer.

DAY OBSERVATIONS.—*Maximum*—22nd, 6°·4; 16th, 21st, and 26th, 5°. *Medium*—25th, 4°. *Minimum*—3rd, 0°·2.

NIGHT OBSERVATIONS.—*Maximum*—31st, 7°·3; 16th and 30th, 6°·4; 17th, 24th, 26th, and 27th, 6°; 14th, 15th, 21st, 25th, and 28th, 5°. *Medium*—12th, 22nd, and 29th, 4°·1; 6th, 4°; 5th, 20th, and 23rd, 3°. *Minimum*—2nd and 4th, 0°·5.

Weather.

Wet—Days, 6; nights, 6. *Fair*—Days, 12; nights, 12. *Cloudy*—Days, 13; nights, 13.

August.

Amount of Cloud.

MAXIMUM OBSERVATIONS.—*Morning*—2nd, 5th, 29th, 30th, and 31st, 10°. *Noon*—6th and 29th, 10°. *Evening*—13th, 18th, 21st, and 30th, 10°.

MEDIUM OBSERVATIONS.—*Morning*—1st, 16th, and 20th, 8°·2. *Noon*—8th and 16th, 4°. *Evening*—10th and 25th, 5°.

MINIMUM OBSERVATIONS.—*Morning*—3rd, 5°. *Noon*—18th, 2°. *Evening*—2nd, 1°.

Ozonometer.

DAY OBSERVATIONS.—*Maximum*—2nd and 23rd, 6°. *Medium*—3rd and 18th, 4°. *Minimum*—10th, 3°.

NIGHT OBSERVATIONS.—*Maximum*—31st, 9°·2. *Medium*—31st, 7°. *Minimum*—5th and 12th, 6°.

SIERRA LEONE.

August 1860.

BAROMETER CORRECTED TO 32° OF SEA LEVEL.

DAYS.	Mercurial Barometer.		Aneroid Barometer.		Ozonometer.		Amount of Cloud.	
	9 A.M.	9 P.M.	9 A.M.	9 P.M.	9 A.M.	9 P.M.	9 A.M.	9 P.M.
1	29·77	29·73	29·8	29·75	5	7	10	9
2	29·67	29·63	29·75	29·65	3	5	10	10
3	29·69	29·63	29·75	29·7	4	8	7	10
4	29·68	29·65	29·75	29·65	10	8	10	3
5	29·71	29·68	29·75	29·7	4	7	10	10
6	29·67	29·64	29·72	29·73	7	8	10	10
7	29·66	29·67	29·75	29·73	5	4	10	10
8	29·68	29·65	29·75	29·65	0	3	10	10
9	29·68	29·64	29·75	29·7	1	0	7	10
10	29·63	29·65	29·67	29·67	2	3	10	10
11	29·78	29·66	29·77	29·75	4	7	9	10
12	29·67	29·66	29·75	29·8	3	8	9	6
13	29·64	29·63	29·67	29·65	3	6	10	10
14	29·66	29·66	29·73	29·67	10	11	9	3
15	29·74	29·72	29·85	29·73	8	3	10	7
16	29·75	29·69	29·87	29·75	0	0	10	9
17	29·65	29·50	29·7	29·7	1	4	3	10
18	29·58	29·56	29·6	29·5	4	10	10	10
19	29·62	29·60	29·65	29·57	3	9	9	8

BAROMETER CORRECTED TO 32° OF SEA LEVEL—*continued.*

DAYS.	Mercurial Barometer.		Aneroid Barometer.		Ozonometer.		Amount of Cloud.	
	9 A.M.	9 P.M.	9 A.M.	9 P.M.	9 A.M.	9 P.M.	9 A.M.	9 P.M.
20	29·63	29·60	29·73	29·67	8	8	9	8
21	29·65	29·62	29·63	29·65	3	2	9	3
22	29·63	29·62	29·7	29·7	2	1	10	10
23	29·63	29·62	29·7	29·7	0	1	9	9
24	29·71	29·70	29·85	29·83	2	8	4	1
25	29·75	29·71	29·9	29·8	0	3	10	10
26	29·74	29·72	29·87	29·85	3	2	10	10
27	29·74	29·69	29·9	29·85	1	7	10	1
28	29·73	29·72	29·9	29·87	10	8	10	7
29	29·75	29·74	29·95	29·9	8	9	7	1
30	29·72	29·69	29·9	29·8	3	4	10	9
31	29·72	29·69	29·9	29·8	3	1	10	9

September.

Amount of Cloud.

MAXIMUM OBSERVATIONS.—*Morning*—2nd, 18th, 22nd, 25th, 26th, 27th, and 28th, 10°, all directions. *Noon*—3rd, 10°. *Evening*—2nd, 23rd, and 30th, 10°.

MEDIUM OBSERVATIONS. — *Morning* — 15th, scattered ; 24th, 5° W.N.W. and S.E. *Noon*—4th, all directions; 8th, N.W.; 28th, 5° E.N.E. *Evening*—22nd, W.S.W.; 24th, 5° W.

MINIMUM OBSERVATIONS.—*Morning*—7th, 0°·3 W. to N. *Noon*—7th, 0°·5 W. *Evening*—24th, 0°·2, scattered.

Ozonometer.

DAY OBSERVATIONS.—*Maximum*—4th, 4° ; 21st and 27th, 3°. *Medium*—6th, 15th, and 22nd, 2°. *Minimum*—1st, 0°·3.

NIGHT OBSERVATIONS.—*Maximum*—4th, 6° ; 1st, 5th, 14th, 15th, and 21st, 5°. *Medium*—2nd, 13th, 18th, 23rd, 24th, and 27th, 3°. *Minimum*—10th and 12th, 1°.

Weather.

Wet—Day, 0 ; night, 0. *Fair*—Days, 24 ; nights, 24. *Cloudy*—Days, 6 ; nights, 6.

BAROMETER CORRECTED TO 32° OF SEA LEVEL.

DAYS.	Mercurial Barometer.		Aneroid Barometer.		Ozonometer.		Amount of Cloud.	
	9 A.M.	9 P.M.	9 A.M.	9 P.M.	9 A.M.	9 P.M.	9 A.M.	9 P.M.
1	29·71	29·70	29·9	29·85	2	4	9	3
2	29·72	29·66	29·9	29·8	3	6	10	9
3	29·66	29·64	29·83	29·8	7	9	10	7
4	29·66	29·65	29·83	28·75	10	7	1	0
5	29·68	29·67	29·83	29·67	10	6	9	10
6	29·72	29·71	29·75	29·75	8	7	10	10
7	29·77	29·72	29·85	29·77	4	6	9	10
8	29·75	29·68	29·8	29·75	1	3	9	10
9	29·67	29·63	29·75	29·67	1	6	10	10
10	29·66	29·68	29·75	29·75	7	1	10	10
11	29·72	29·71	29·83	29·8	0	1	10	10
12	29·71	29·68	29·8	29·75	7	0	9	10
13	29·69	29·64	29·75	29·67	0	0	10	4
14	29·68	29·66	29·7	29·63	0	1	4	1
15	29·65	29·67	29·67	29·65	0	1·3	9	10
16	29·7	29·70	29·75	29·7	0	3	10	10
17	29·72	29·69	29·8	29·75	2	5	8	9
18	29·73	29·66	29·8	29·7	2	6	4	10
19	29·7	29·63	29·77	29·7	0	3	10	4
20	29·66	29·62	29·7	29·65	2	1	2	3
21	29·63	29·65	29·67	29·63	1	3	10	10
22	29·65	29·65	29·7	29·7	1	4	10	9
23	29·69	29·65	29·75	29·67	0	8	6	7
24	29·64	29·67	29·7	29·67	0	0	9	9
25	29·64	29·69	29·67	29·65	0	0	3	1
26	29·69	29·66	29·7	29·65	1	1	5	10
27	29·71	29·65	29·75	29·75	0	0	10	10
28	29·69	29·66	29·77	29·7	0	0	7	10
29	29·66	29·64	29·67	29·67	1	2	6	10
30	29·62	29·62	29·6	29·6	6	1	2	8

October.

Amount of Cloud.

MAXIMUM OBSERVATIONS.—*Morning*—3rd, 19th, and 24th, 10°, all directions; 6th, 10th, and 26th, 8°·2, all directions. *Noon*—3d, N. to W. and S.W.; 10th, all directions; 17th, 10° W. to N.W. *Evening*—1st, W.N.W.; 2nd, all directions; 10th and 24th, 10°.

MEDIUM OBSERVATIONS.—*Morning*—9th, scattered; 17th, 5° N.W. and S.W. *Noon*—6th, S.E. to N.W.; 26th, 5°, scattered; *Evening*—18th, scattered; 25th, 5°, N. and S.E.

MINIMUM OBSERVATIONS.—*Morning*—7th, S.W. to S.; 16th, W. and N.E.; 18th and 25th, 1°, scattered. *Noon*—25th, 0°·3, S.W. to NE. *Evening*—4th, 0°·5. W.N.W.

Ozonometer.

Day Observations.—*Maximum*—30th and 31st, 5°; 25th, 4°·9. *Medium*—4th, 14th, 16th, 23rd, 24th, 26th, and 29th, 3°. *Minimum*—2nd, 0°·2.

Night Observations.—*Maximum*—31st, 7°·4; 16th, 26th, and 30th, 6°·4. *Medium*—22nd and 28th, 4°. *Minimum*—14th, 0°·3.

Weather.

Wet—Days, 2; nights, 10. *Fair*—Days, 20; nights, 14. *Cloudy*—Days, 9; nights, 7.

Barometer corrected to 32° of Sea Level.

DAYS.	Mercurial Barometer.		Aneroid Barometer.		Ozonometer.		Amount of Cloud.	
	9 A.M.	9 P.M.	9 A.M.	9 P.M.	9 A.M.	9 P.M.	9 A.M.	9 P.M.
1	29·63	29·63	29·67	29·67	1	0	10	8
2	29·67	29·64	29·73	29·65	1	3	8	8
3	29·59	29·66	29·7	29·7	1	0	10	9
4	29·67	29·65	29·67	29·63	1	2	2	10
5	29·65	29·65	29·67	29·67	1	1	9	10
6	29·66	29·68	29·77	29·77	0	1	10	10
7	29·69	29·69	29·77	29·77	2	0	4	1
8	29·71	29·7	29·8	29·8	1	0	8	2
9	29·72	29·71	29·87	29·71	1	1	5	1
10	29·68	29·69	29·77	29·77	0	3	9	3
11	29·65	29·64	29·7	29·67	3	2	2	2
12	29·6	29·65	29·6	29·7	1	0	2	8
13	29·65	29·68	29·7	29·75	10	0	1	6
14	29·68	29·7	29·77	29·8	0	2	9	10
15	29·7	29·68	29·8	29·75	0	1	3	4
16	29·72	29·68	29·83	29·75	1	1	10	3
17	29·69	29·65	29·85	29·75	1	1	9	5
18	29·76	29·77	29·83	29·77	1	0	3	3
19	29·68	29·66	29·8	29·73	0	0	5	9
20	29·66	29·62	29·75	29·6	0	0	0	3
21	29·67	29·61	29·73	29·73	0	0	8	5
22	29·62	29·62	29·73	29·75	0	1	4	2
23	29·61	29·61	29·77	29·73	1	1	8	10
24	29·61	29·62	29·73	29·7	5	2	3	8
25	29·65	29·66	29·73	29·73	1	0	3	8
26	29·66	29·61	29·77	29·7	1	1	9	1
27	29·67	29·63	29·77	29·73	1	0	9	5
28	29·64	29·68	29·82	29·8	2	2	10	5
29	29·62	29·64	29·73	29·75	4	4	3	10
30	29·6	29·62	29·7	29·73	7	6	1	2
31	29·59	29·57	29·67	29·67	2	4	2	3

November.

Barometer.

Maximum Observations.—*Morning*—10th, 30°·77; 12th, 30°·75; 17th and 25th, 30°·74. *Noon*—13th and 15th, 30°·80; 17th, 30°·75. *Evening*—9th and 14th, 30°·80.

Medium Observations.—*Morning*—13th, 14th, 15th, 16th, 19th, 21st, 23rd, 24th, and 27th, 30°·70. *Noon*—9th, 19th, and 24th, 30°·70. *Evening*—16th and 17th, 30°·70.

Minimum Observations.—*Morning*—29th, 30°·66. *Noon*—16th, 30°·68. *Evening*—17th, 30°·70.

Weather.

Wet—Days, 3; nights, 7. *Fair*—Days, 25; nights, 20. *Cloudy*—Days, 2; nights, 3.

December.

Barometer.

Maximum Observations.—*Morning*—14th, 30°·75; 2nd, 9th, 12th, 23rd, and 29th, 30°·70. *Noon*—3rd, 4th, 6th, 7th, 15th, and 25th, 30°·70. *Evening*—16th and 17th, 30°·73; 15th and 22nd, 30°·70.

Medium Observations.—*Morning*—14th, 30°·68. *Noon*—8th and 20th, 30°·69. *Evening*—10th, 30°·69.

Minimum Observations.—*Morning*—7th, 30°·55. *Noon*—9th, 30°·68. *Evening*—6th, 30°·65.

Weather.

Wet—Days, 0; nights, 2. *Fair*—Days, 29; nights, 24. *Cloudy*—Days, 2; nights, 5.

Barometrical Observations taken at the Military Hospital, Freetown, Sierra Leone, in 1820. (Boyle.)

Months.	Barometer.			Months.	Barometer.		
	Max.	Med.	Min.		Max.	Med.	Min.
January ...	29·99	29·93	29·80	July	30·0	29·87	29·81
February ..	30·30	29·91	29·81	August	29·91	29·70	29·82
March......	30·40	29·95	29·87	September.	29·93	29·91	29·84
April........	30·99	29·85	29·81	October	30·10	29·87	29·30
May.........	30·91	29·85	29·82	November.	30·20	29·86	29·20
June........	30·92	29·86	29·81	December..	30·40	29·30	29·60

CHAPTER IX.

THE SEASONS OF WESTERN AFRICA—GENERAL OBSERVATIONS—THE SUMMER SEASON.

The division of the year into seasons must depend entirely on the climate of the country; and, consequently, we find it to present endless varieties in different latitudes, and this is governed by the unequal distribution of light and heat, caused by the spherical condition of the earth; by its obliquity in relation to the equatorial plane; by its axial diurnal revolution, and by "its motion in its elliptical orbit, by which every part of the surface between 23½ north and south latitudes are in turn exposed to the perpendicular influence of the sun's rays."

Spring, summer, autumn, and winter.

Amongst the ancient Greeks and Egyptians the year was divided, as it now is in England, into *spring*, *summer*, *autumn*, and *winter;* but their respective dates of commencement and termination differ materially, each having special reference to their respective climate. Thus, with the *first*; *i. e.*, the ancient Greeks, *spring* commenced on or about the 20th of March, when the sun enters the first degree of Aries, and terminates on or about the 7th of May, at the heliacal rising of the Vergiliæ or Pleiades: with the *second*, *i. e.*, the Egyptians, *spring* occupies the months of January and February: with the *third*, *i.e.*, the English or modern, *spring* commences at the *vernal equinox*, on the day or hour when the distance of the meridian altitude of the sun from the zenith is at a mean between the greatest and the least, which is the 20th of March,

and terminates on or about the 21st of June, as soon as the sun is about to enter the first degree of Cancer.

With the *first*, the *summer* commences from the 7th of May to the heliacal rising of *Sirius*, a star of the first magnitude in the constellation *Canis major;* or on the heliacal rising of *Arcturus*, a star also of the first magnitude in the constellation *Bootes* or *Arctophylax*, which takes place about the 15th September; sometimes it is reckoned from the heliacal rising of *Procyon*, in the constellation *Canis minor:* with the *second*, the *summer* commences in March and continues on to the end of August: with the *third*, the *summer* commences on the *summer solstice*, or the hour when the sun attains its maximum distance from the equator, or northern declination, *i. e.*, 21st June, and terminates on or about the 22d of September, just as the sun is about to enter Libra.

With the *first*, the *autumn* commences on or about the 15th September, at the heliacal rising of *Sirius*, *Arcturus*, or *Procyon*, and terminates about the 5th of November; or the heliacal setting of the *Vergiliæ* or *Pleiades:* with the *second*, the *autumn* commences in September and terminates with the last day in October: with the *third*, the *autumn* commences on the beginning of the *autumnal equinox*, or the day the meridian distance of the sun from the zenith is at a mean between the greatest and the least, viz., about the 22d September, and terminates on or about the 21st day of December, just as the sun is about to enter Capricornus.

With the *first*, the *winter* commences with the heliacal setting of the *Pleiades*, on or about the 5th November, and terminates on the day the distance of the sun's meridian altitude from the zenith is at a mean between the greatest and the least: with the *second*, the *winter* commences in November and terminates in December: with the *third*, the *winter* commences on or about the 21st of December, on the *winter solstice*, when the distance of the sun from the zenith is greatest, and terminates at the *vernal equinox*.

From the foregoing, therefore, it proves that amongst the

ancient Greeks the spring had a duration of 48 days; the summer, 131 days; the autumn, 51 days; and the winter, 135 days. Amongst the Egyptians, the spring, 59 or 60 days; summer, 184 days; autumn, 61 days; winter, 61 days. Amongst the English, or modern calculators, the spring, 93 days; summer, 93 days; autumn, 90 days; and winter, 89, or in leap year, 90 days.

Number of days each season occupies.

The seasons on the West Coast of Africa present certain varieties, from the extent of coast line to be taken into consideration, and the different latitudes and local peculiarities of the different places; but for the sake of uniformity I might divide it into four seasons or quarters, viz., the *summer*, *rainy*, *harvest* or *autumn*, and *harmattan*.

Seasons of Western Africa.

The *summer* season commences on or about the 15th of February, and terminates about the end of April, or more properly on the 15th of May, occupying about 89 or 90 days.

The *rainy* season commences about the 15th May, and terminates on the 31st August, having a duration of 108 days.

The *harvest* or *autumn* commences on the 1st September, and terminates on or about the 15th November, having a duration of 76 days.

The *harmattan* commences about the 15th November, and terminates about the 15th February, having a duration of 93 days.

But this cannot be said to be literally true in all parts of the whole West Coast, as it is characteristic more of the climate of Sierra Leone and Liberia. In the region of the trade winds (*vide* Chap. VII.), the summer commences on the 15th February and terminates about the 10th June, and sometimes the rains do not commence until the 1st July, and terminate in the beginning of September. In the northern portion of the zone of calm, or region of variable wind, including Sierra Leone and Liberia, the rains commence on the 1st of May, the harmattan in December. On the Gold Coast and Bights the rains commence in the beginning of April, and there is scarcely any harmattan; the period from October to March being very hot, may be regarded as the summer season. For all prac-

tical purposes, the division we have adopted will be found most advantageous in the consideration of the seasons of Western Africa; and must commence with the

SUMMER SEASON—*February, March, and April.*

Summer, description of.

The weather at this quarter is hotter than at any other period, but this varies in different parts of the coast. In the regions of the trade winds the maximum of heat is felt; then the heat is greater in Sierra Leone and Liberia than the Gold Coast and Bight of Benin, from the peculiar and perfect exposure of the latter to the influence of the sea breeze.

Thermometer

In the Gambia and its interior the average maximum thermometer in this season is 106°; the medium, 100°, and the minimum about 83°. At Sierra Leone and Liberia the average maximum is about 85°, the minimum about 80°, and the minimum, 79°. Of the barometer the average maximum is 30·41 inches; medium, 29·95; minimum, 29·87. On the Gold Coast the average maximum thermometer is about 84°; the medium, 80°; minimum, 78°.

Winds.

The direction of the winds vary also.

In the Gambia region, including Senegal and the Casamanza—

February, March, and beginning of April, N.E., E., and S.E.
Towards end of April, varied round the compass.

In Sierra Leone and Liberia—

February and March, N.W. to W.
April, S.W. to N.W.

On the Gold Coast and Bights—

February, morning, N.E. and E.; during day, S.W.
March, S., S.W., and W.
April, W., S., S.W.

Simoom, description and effects of.

Besides these constant winds in the Gambia region, or the region of the trade winds, an irregular wind, in April and May, generally blows from the desert, and varies from every part of the compass. It is very dry and excessively hot. The thermometer rises from 106°; the average, to 114° under shade

The horizon at its approach has a red or purple tinge. The air, oppressively hot, is surcharged with fine white sand, the breathing interrupted or greatly quickened, the nasal membranes burn as the wind enters it. I was under the influence of two of these winds. Its exact counterpart can only be represented by a *blast from the furnace*, or the *sudden opening of a heated oven*. The pores of the body are so relaxed that they yield profuse perspiration; the exposed sentient surface burns as the heated air approaches it; individuals are prostrate and gasp for breath. The drinking water in the most porous Teneriffe cooler becomes lukewarm; drinking tumblers are so hot that they require to be submerged for some minutes before being used. There is never a necessity for the use of blotting paper, the last written word being dried up in a second.

Vegetation suffers materially from the effects of this wind. The leaves dry and become disarticulated, the young plant stinted and withered, and no amount of watering will keep an herbaceous plant in vigour; the ground is parched and cracked in various directions; the clay for the time becomes almost as hard as bricks.

Persons suffering from diseases of the lungs suffer most intensely from this wind. They are much prostrated and oppressed; they feel an unaccountable cold chill all over their body, and no amount of hot clothing seems to reduce the chill; they pant for breath as "the hart panteth after the water brooks," but every heated puff gives them no satisfaction whatever. I have seen cases where they lay restless for hours, as if death would be the only relief to their sufferings. The most pleasant sensation is felt when cold water is thrown over the face, or when the face is covered with a wet thin cambric handkerchief, and exposed to the current of the heated air.

The night is the most distressing part of the twenty-four hours. The bed-clothes are as hot as the natural heat of the body. The least slumber produces the most profuse perspiration, and before morning the nightgowns must be changed four

or five times. Indeed, I have known individuals to damp their bed linen before going to rest without suffering the least injurious effects from it.

Greek and Arabic name.

This wind, which is allied to, if not identical with, the *Simoom* of the desert, is the same as the *gādīm*, or east wind of the Old Testament, or the *shŭrgiyeh* of the Arabs. Reference is made to it in Job xv. 2, in Hosea xiii. 15, and in Ezekiel xvii. 10, xix. 12. "Behold, being planted, shall it prosper? shall it not utterly wither when the east wind toucheth it? it shall wither in the furrows where it grew."

When only the ordinary winds blow, the atmosphere of the Gambia region contains a larger quantity of aqueous vapour during this season than that of any other part of the coast. The maximum quantity is generally after noon, and the minimum before sunrise. On the Gold Coast the maximum of heat is between one and two o'clock, through the accession of the south-west sea breeze.

Whirlwind, description of.

During this season of the year *whirlwinds* are very frequent, and in many cases dangerous. Their constant and violent gyratory or whirling motion from or about a central axis, is caused by two currents of wind having opposite directions, blowing in close proximity with one another. Both cannot have the same velocity, and the stronger attracts the weaker into its own movement, diverting it from its own course, and thus keeping up a continual movement. Before the latter changes its course it undergoes a certain amount of condensation, and the degree of this determines the force and velocity of the whirlwind. Their axes are placed in curvilinear or rectilinear line with the surface of land or water, and they move with the moving atmosphere around them.

There are several cases known in the interior of the River Gambia, between M'Carthy's Island and the falls, where vessels have narrowly escaped being upset by whirlwinds in the river. In 1864, the "Diamond," a small craft which was loaded with a deckload of ground nuts at Fattah Tendah, was caught in one of these movements, and was

quickly deprived of the temporary bulwarks made of thick mats with which it was supplied, and would have been capsized but for the alertness of the captain.

In the next chapter it will be shown, that as the temperature increases the air becomes drier; for every increase of 27° F. it becomes double, so that whilst the temperature increases in an arithmetical progression, the dryness increases in a geometrical progression. Thus, the interior of the Gambia region, where the temperature sometimes exceeds 112° F., the atmosphere contains less moisture than the atmosphere in Sierra Leone, Liberia, the Gold Coast, and Bights, where the temperature seldom exceeds 90° F. How far this dry atmosphere is more conducive to health than the moist warm air, I shall consider in another place.

The following table, taken from Pickford, shows the elastic force or tension of aqueous vapour in inches of mercury (Dr Dalton), and the weight, in grains Troy, of a cubic foot of vapour (Gay-Lussac), from 50° to 135° Fahrenheit.

ELASTIC FORCE OF AQUEOUS VAPOUR.

Temperature Fahrenheit.	Elastic Force of Aqueous Vapour in Inches of Mercury.		Weight in grains Troy of a Cubic Foot of Vapour at the Sea Level.	Temperature Fahrenheit.	Elastic Force of Aqueous Vapour in Inches of Mercury.		Weight in grains Troy of a Cubic Foot of Vapour at the Sea Level.
	Dalton.	Formula.			Dalton.	Formula.	
50°	0·375	0·45	4·28	68°	0·676	0·82	7·53
51	0·388	0·47	4·42	69	0·698	0·85	7·76
52	0·401	0·49	4·56	70	0·721	0·88	8·00
53	0·415	0·51	4·71	71	0·745	0·91	8·25
54	0·429	0·53	4·86	72	0·770	0·94	8·50
55	0·443	0·55	5·02	73	0·796	0·97	8·76
56	0·458	0·57	5·18	74	0·823	1·00	9·04
57	0·474	0·59	5·34	75	0·851	1·03	9·31
58	0·490	0·61	5·51	76	0·880	1·06	9·60
59	0·507	0·62	5·69	77	0·910	1·09	9·89
60	0·524	0·64	5·87	78	0·940	1·12	10·19
61	0·542	0·66	6·06	79	0·971	1·16	10·50
62	0·560	0·68	6·25	80	1·00	1·20	10·81
63	0·578	0·70	6·45	81	1·04	1·24	11·11
64	0·597	0·72	6·65	82	1·07	1·28	11·47
65	0·616	0·74	6·87	83	1·10	1·31	11·82
66	0·635	0·77	7·08	84	1·14	1·36	12·17
67	0·655	0·80	7·30	85	1·17	1·39	12·53

ELASTIC FORCE OF AQUEOUS VAPOUR—*continued.*

Temperature Fahrenheit.	Elastic Force of Aqueous Vapour in Inches of Mercury.		Weight in grains Troy of a Cubic Foot of Vapour at the Sea Level.	Temperature Fahrenheit.	Elastic Force of Aqueous Vapour in Inches of Mercury.		Weight in grains Troy of a Cubic Foot of Vapour at the Sea Level.
	Dalton.	Formula.			Dalton.	Formula.	
86°	1·21	1·44	12·91	97°	1·68	1·96	...
87	1·24	1·47	13·29	98	1·74	2·01	...
88	1·28	1·51	13·68	99	1·80	2·08	...
89	1·32	1·56	14·08	100	1·86	2·15	...
90	1·36	1·61	14·50	105	2·18	2·48	...
91	1·40	1·65	...	110	2·53	2·83	...
92	1·44	1·69	...	115	2·92	3·25	...
93	1·48	1·74	...	120	3·33	3·69	...
94	1·53	1·79	...	125	3·79	4·19	...
95	1·58	1·84	...	130	4·34	4·78	...
96	1·63	1·89	...	135	5·00	5·41	...

CHAPTER X.

THE RAINY SEASON—MAY, JUNE, JULY, AND AUGUST.

General observations.

At this season of the year the meteorological phenomena are numerous. The atmosphere is generally cloudy, heavy, and misty, with occasional lightnings and peals of thunder. The evenings are generally very dark, or if the moon be present, it is seen through a misty atmosphere. Shooting stars are occasionally present, running in every direction, at a distance apparently of about 1000 feet from the surface of the earth, proving that the atmosphere is highly impregnated with electric fluid. There are at the commencement occasional showers of refreshing and cooling rains. The thermometer and barometer present much variation. Now every one begins to prognosticate "what kind of a season it would be." Some are glad to have a more refreshing and moist weather, but dread the sequelæ of the commencing rains; others are filled with unpleasantness at the anticipation of a drawback in the trade, especially with surrounding tribes; whilst a third, the horticulturists, sharpen their hoes and garden implements with delight; and the agriculturist, with an agility that is delightful to behold, digs, rakes, and prepares his fields, looking out for an abundant harvest.

From May the rain gradually increases until July and August, when it comes down with terrific rapidity, swelling large streams into navigable rivers, converting brooks into rivulets which sweep away every vegetable that is planted near them, and overflowing the banks of small streams. Many pasture lands are inundated, so that in many places water

may be seen oozing from the earth. The thatch in grass-roofed houses is sometimes torn away by its tremendous, rapid, and unremitting torrents, so that in some huts the inhabitants are washed whilst enjoying the visible caloric emanating from a blazing fire. Bridges built *pseudo*-substantially disclose the unskilfulness of the architecture, and man is obliged to shelter himself under the canopy of some cloth of Manchester or Glasgow manufacture, supported by curiously-wrought whalebones and pine-wood.

Everything in the vegetable world seems pleasing; "the fields luxuriate in the abundance of their vegetable stores; the trees rejoice in their leafy pride; the varied flowers raise their heads; whilst beauteous nature revels in the soft voluptuousness of her own creation;" and man views with glowing pleasure the resuscitation of the lifeless plants.

Causes of rain.

Rain is produced by two currents of air of unequal temperature, but of equal degree of saturation, meeting together in equal volume. The resultant temperature is the mean of the two; but the invisible aqueous vapour not being the mean, but exceeding that of the mean of the resultant temperature, the difference is deposited in the form of rain or dew. Thus, if at Freetown, or at the foot of the Cameroon Mountains, the temperature of the air be 86° in a state of absolute saturation, and, being specifically lighter on ascending to the top of Sugar-Loaf or the Cameroon Mountains, meets with a cold air, which reduces its temperature to 59°, it will part with the fortieth part of its weight of aqueous vapour in the form of rain. Rain, then, is the cooling down of a saturated air below its point of saturation. The dryness of the air at every increase of 27° F. is doubled; thus, at 32° it holds the 160th part of its weight of moisture; at 59°, the 80th part; at 86°, the 40th part; and at 113°, the 20th part.

The quantity of rain-fall is very much affected by the phases of the moon; it increases when the moon crosses the equator, and about new moon; then near the full moon it is very heavy; at full moon, and during her decline to the

equator, there is a minimum quantity of rain; but this depends on the relative position to the sun.

The drops of rain vary in diameter from the one-third to the one-thirtieth of an inch, and might be caused by various circumstances. If the separated moisture or aqueous vapour, several feet above the surface, pass through a stratum of air warmer than the mean of the two from which it had been separated, it might suffer suspension in it, or fall in very small drops; but when it passes through a colder stratum of air, the size of the drops become increased during the descent.

Substance taken up by rain from air.

In passing through the air, rain-water contains a large quantity of oxygen and carbonic acid, and may also contain small quantities of carbonate of ammonia, nitric acid, nitrate of ammonia, sulphurous acids, and sulphuric sulphuretted hydrogen, phosphoric and hydrochloric acids, chlorides of sodium and potassium, carbonate and sulphate of lime, and traces of nitrogenous organic matter. In fact, "the rain, in falling, carries with it everything that floats in the atmosphere, and which is not essential to its constitution; it brings back to the earth what came from the earth; and while it thus purifies the atmosphere from hurtful adulterations, restores to the soil these numberless volatile substances, where they have abundant opportunities of forming not only harmless, but useful combinations" (Mulder).

The fall of rain in intertropical Western Africa is not daily throughout the year, but only at particular seasons, and this is caused by the change in the direction of the trade-wind. In the Gambia region, including Senegal, the rain does not commence before the 10th June, very often not before the 1st July; at Sierra Leone and Liberia about the 1st May, and on the Gold Coast and Bight of Benin about the 1st of April.

Tornadoes, description of.

The commencement of the rainy season is always marked by two, three, or more tornadoes, and it answers to the breaking up of the monsoon. The word "tornado" is derived from the Portuguese *travado,* which means a thunderstorm. At this time of the year, as well as after the rain, when the tornado

season again approaches, there is an evident increase of ozone in the atmosphere, caused by the highly electrified condition of the atmosphere. The occurrence of a tornado is generally marked with premonitory symptoms. At first a cold breeze is felt, which is soon followed by a clear, white, heavenly canopy, giving the atmosphere a kind of light rusty appearance. At once a dusky white spot is observed, pointing E.S.E., or E., at a great altitude, which gradually descends, spreading at the same time until it reaches the horizon, forming sometimes a cone—the base on the horizon, and the apex above; this spreads laterally until a half or a quarter of the visible horizon is covered with impenetrable darkness. Nature now seems to lie in dormant vitality, and its functions to be seized with a paralytic stroke; the most profound quietness pervades the whole earth; the leaves are perfectly at a stand still, not a creature is to be seen about in the street; the whole system now becomes oppressed with a mingled sensation of awe and apprehension of some stupendous phenomena. A once a blast of lightning vividly flashes from sky to sky, and then darting on the negatively electrified ground is followed immediately by a distant tremendous reverberating explosion, which startles every terrene animated being. A slight whirlwind is afterwards observed whirling with some velocity the light ponderable material found in the streets. At length a vehement, irresistible gust of wind rushes from the gloomy horizon with immense impetuosity, sweeping every unsubstantially fixed substance before it, uprooting trees, carrying away slates and bamboos from the tops of houses, and sometimes even the roofs and chimney tops, and filling the atmosphere with an immense quantity of *infusorial protozoa;* then follow thick pellets of rain, which as it were retreat for a time, returning and terminating with a furious deluge, which falls in one vast sheet rather than in drops.

The above is a general description of a tornado. It will be of some interest and of more practical value should I here particularise all the various changes, carefully observed and noted, of two tornadoes as they occurred on the West Coast of Africa.

The observations were made whilst our troops were stationed at Quittah, on the Slave Coast, in the Bight of Benin.

At 4.14 P.M. there was a dark, bluish-black cloud on due E., which extended in the next quarter of an hour to E.N.E. and E.S.E.; at 5 o'clock it had extended to S.E. by S., and then to due S. The appearance of the cloud from the horizon to 1° above was dark bluish-black, above this it was white; the latter suddenly and rapidly descended and overclouded the former. During this period there was a dead calm all over the atmosphere; not the least movement was traceable in the most fragile branch; the sky towards S.W. by S. to N.N.E. was perfectly clear. At last the pent-up wind seemed, as it were, to overcome the difficulty, and the cloud was thrown all over the canopy; the wind now rushed from E.N.E., accompanied with a deluge of rain.

It will be observed that, in this description of a tornado, there was no lightning nor thunder, as is sometimes the case; the observation was made on the 1st of May.

The following are the particulars of another tornado, which took place about the latter part of March on the same coast:—Wind on the beginning of the tornado E.; darkness all over the heavens, and thunder towards the east. No rain at the beginning; haziness all over the canopy, especially towards the sea, with heavy fog drifting from east to west. A pleasant light rain now fell in small drops, and lasted for a short time, which was followed by a violent gust of wind, and a clearness over the whole atmosphere from E. to S.E. The wind now stopped for a short time, but immediately returned with great force and velocity. A dense fog now covered the horizon, the greatest distance that could be seen around being less than half a mile, more or less covered with fog. Twenty minutes after this the wind gradually decreased and the rain became more tense. Grumblings of thunder now began to be heard from S. to E., and increased in frequency and intensity; the wind became vehement, and the rain gradually ceased. About ten minutes after, the wind decreased, but the rain increased;

the thunder became violent from the zenith to S.W. by W.; then to E. by S. ½ S., and then S.E. The wind now alternated with the rain; the thunder from N.W. to S; then heavy rain fell, with thunder to E. zenith S., and terminated in S.W. The sky began to get clear; the thunder continued in severity, with vivid flashes of lightning in various directions, and after a time all the phenomena ceased, and a most pleasant sensation was felt.

There are at this period of the year, especially at the closing of the rains or harvest, repeated recurrence of forked or penetrating and vivid flashes of sheet lightning, which in many cases occasions a peculiar sensation of a delightful and agreeable character on the exposed sentient surface. Mr Hutchinson describes it as "a dash of increased heat simultaneous with a vivid flash of lightning;" and the late Dr Baikie, as "a feeling of warmth in the face." This feeling I believe to be caused by an increased development of ozone by each flash, which, being a powerful and energetic oxidising substance, oxidises the oxidisable from transpiration emanating the surface of body. After the tornado, the most pleasing sensation is felt; the air is refreshingly cold, clear, and exhilarating, containing a large quantity of oxygen, and the constitution much invigorated; for in the second tornadal observations above described, the thermometer fell from 86° to 78°, the hygrometer was 3°, dew-point 74°, saturation of the atmosphere 881·4, and tension of aqueous vapour 0·957. There was an increase of 2° in the ozonometer.

After effects of tornado.

In the Gambia region, towards the approach of the rainy season, the wind, which had been most constantly blowing from the monsoon points N., N.E., and E., now blows all the day with violence from S.W., W., and N.W., which greatly cools the atmosphere, although in some days the thermometer goes up as high as 106°. The temperature before sunrise is very chilly, and individuals are very much subject to colds and coughs. The rains here are ushered in by one or two *dirt gales*. Thus in 1866, the rainy season at M'Carthy's Island commenced literally on the 22d June. A few days previously

Dirt gales.

there was a severe dry gale from the direction between south-east and north-east, blowing with tremendous velocity everything before it. Its approach was indicated by a deep grumbling noise a mile off, and the moving column of air appeared as a dense black fog, but was composed of dirt; it removed all the light surface earth, and wafted it along with great velocity, and unless individuals were under shelter, it was impossible to breathe without taking into the lungs a large quantity of dust. It continued with varied velocity for half an hour, and then gradually subsided. On the 21st the mid-day sun was very oppressive; towards evening a strong south-west wind blew, the atmosphere clear, the moon bright and the heavens starry; at 3 A.M. of the 22d the rains were ushered in with a severe north-east wind blowing into a tornado.

On the Gold Coast and the Bights the rains commence earlier, but do not continue until September. They terminate about the beginning of June, occasioning the former rains. The latter rains commence about the beginning of July, and terminate at the end of August. But in Liberia, Sierra Leone, the Gambia, and Senegal, when the rains once commence, they gradually increase until towards the end.

Calculation of quantity of rain at Sierra Leone in 1829, 1858, and 1860.

From the Rio Pongas to Liberia the rains are more plentiful than at any part of the coast; but the quantity varies a great deal every year. The maximum quantity which fell at Freetown, Sierra Leone, according to the observation which was taken at the military hospital in August 1860, in the twenty-four hours, was 2·61 inches, which was on the 28th of the month; in September it was 4·27 inches on the 1st; and in October, 4·65 on the 6th. The minimum was in August, ·04 on the 10th; in September, ·05 on the 23d; October, ·01 on the 28th. The total quantity of rain during the whole of August was 26·86 inches; in September it was 25·35 inches; and in October, 13·80 inches. In April of the same year, the total quantity which fell was 3·56 inches; in May it was 10·24 inches; and in June it was 15·23 inches. The observations taken from the 1st to Friday the 28th.

If we refer to the tables published by Boyle, as the observations taken in the same hospital in the months of June, July, and August 1829, it will be found that the quantity of rain which fell must have been enormous, and was quite sufficient to inundate the whole of the country, mountainous though it is, and goes far to prove that there are sensible differences between the meteoric phenomena of the last thirty years and the present time.

The maximum quantity of rain in the twenty-four hours in June 1829, was 4·40 inches on the 11th; in July it was 14·15 inches on the 10th; and in August 16·00 inches on the 23d. The minimum quantity in June was 1·10 inches on the 8th; in July it was 1·00 inches on the 16th; and in August 1·00 on the 29th. The total quantity of rain during the whole of June was 64·55 inches; during July it was up to 125·55 inches, and in August it fell to 123·80 inches.

In 1858 the total quantity of rain which fell in the three months, viz., May, June, and July, as observed in the gauge kept at Fourah Bay, Freetown, was as follow:—May, 8·95 inches; June, 12·27 inches; July, only 23·50 inches.

TABULAR SUMMARY FOR 1829, 1858, 1860.

Months.	Total quantity of Rain in inches.			Difference between 1860 and 1858.	Difference between 1829 and 1858.	Difference between 1829 and 1860.
	1829.	1858.	1860.			
April	...	...	3·56	...	...	...
May	...	8·95	10·24	1·34	...	...
June	64·55	12·27	15·23	2·96	52·28	49·32
July	125·55	23·50	...	...	102·05	...
August	123·80	...	26·86	...	...	96·94
September...	...	...	25·35	...	...	...
October	...	...	13·80	...	...	...
Total, ...	303·90	34·72	95·04	4·30	154·33	146·26

From the above table it will be seen, that the total quantity of rain which fell in the three months of June, July, and August in 1829, was 303·90 inches; the total in May, June, and July

in 1858, was 34·72; whilst the total of the six months in 1860, viz., April, May, June, August, September, and October, was 95·04. The difference between the quantity of rain which fell in May 1858, and the same month in 1860, was 1·34 inches in favour of the latter year; whilst the difference between June 1829 and June 1858, and between the same months in 1829 and 1860, are all in favour of 1829—viz., in the first case it was 52·28 inches, and in the second 49·32. In 1860 of the same month there was more rain than in 1858 of the same month by 2·96 inches. July 1829 had more rain than July 1858 by 102·05 inches, and August 1829 more than August 1860 by 96·94 inches. It is evident, therefore, that if the table of Boyle be correct, of which I have not the least doubt, the quantity of rain in 1829 must have been excessive. The quantity in June alone is nearly twice the quantity in May, June, and July of 1858, being 64·55 and 34·72 respectively; and the quantity in August alone of 1829 exceeds the quantity of the six months in 1860, viz., April, May, June, August, September, and October, by 28·76. The sum total of the rain which fell in the three months, June, July, and August of 1829, exceeds the sum total of the quantity which fell in the three months, May, June, July of 1858, and the six months, April, May, June, August, September, October of 1860, by 174·24 inches, or more than double the quantity by 44·48 inches.

What, most of my readers will ask, *is an inch of rain?* And what equivalent in avoirdupois weight must be understood by these figures, 303·90 inches, 34·72 inches, 95·04 inches?

An inch deep of rain in one acre of land yields 22,622·5 gallons of water; but 277·274 cubic inches is equal to one gallon, therefore, an inch deep of rain in one acre of land is equal to 6,372,640 cubic inches of water, since an acre, according to the English measurement, consists of 6,272,640 cubic inches.

Rain water must be considered as the purest of natural waters, especially when collected after a long continuance of

rainy weather, and even then it will be found to contain an appreciable quantity of atmospheric air, together with some of the gases floating in it, to the extent of about $2\frac{1}{2}$ cubic inches of air in 100 of water. Distilled water, therefore, is the best material for experiment, a gallon of which weighs 10 lbs.; and one inch deep of rain being equal to 22,622·5 gallons of water, consequently the rain-fall on an acre of land is equal to 226,225 lbs. avoirdupois; but 2240 lbs. is equal to one ton, therefore an inch deep of rain weighs nearly 101 tons, or more correctly, 100·993 inches.

The quantity of rain, therefore, which fell in an acre of land at Freetown, Sierra Leone, in the months of June, July, and August of 1829, was not less than sixty-six millions six hundred and fifty-nine thousand five hundred and sixty pounds avoirdupois of water, or six millions six hundred and sixty-five thousand nine hundred and fifty-six gallons of water, or thirty thousand three hundred and ninety tons. Allowing Freetown to be about three miles square, it will contain one thousand nine hundred and two acres; and, therefore, the quantity of rain which fell in all Freetown for the three months in 1829, if measured, will not be less than twelve billions six hundred and seventy-eight millions six hundred and forty-eight thousand three hundred and twelve gallons of water, or one hundred and twenty-six billions seven hundred and eighty-six millions four hundred and eighty-three thousand one hundred and twenty pounds weight of water, or fifty-seven millions eight hundred and one thousand seven hundred and eight tons of water. What an enormous quantity for only eighty days of rain!!!

Leaving unnoticed the quantity of rain which fell in the three months of 1858, which was represented by 34·72 inches, let me consider that of the six months in 1860, which amounted to 95·04 inches; there were twenty-one million two hundred and eighty thousand nine hundred and sixty lbs. of water, or two millions one hundred and eighty thousand eight hundred and ninety-six gallons, which is equal to nine thousand five hun-

dred and four tons of water in an acre. But the whole of Freetown has been shown to contain no less than one thousand nine hundred and two acres of land, so that the quantity of rain, which fell in the whole of Freetown in 1860, is represented in pounds avoirdupois by forty-seven billions six hundred and eighty-seven millions two hundred and seventy thousand and four hundred, in gallons by four billions seven hundred and sixty-eight millions seven hundred and twenty-seven thousand and forty, and in tons by eight millions and seventy-five thousand six hundred and eight.

But there were 208·86 inches of rain in the three months of 1829, more than in the six months of 1860, *i.e.*, there fell in an acre of land at Freetown forty-six millions seven hundred and eighty-four thousand six hundred and forty lbs. of water, or four millions six hundred and seventy-eight thousand four hundred and sixty-four gallons, or twenty thousand eight hundred and eighty-six tons of rain more than in the year 1860.

It might be doubted that so large a quantity of rain-fall could have taken place in 1829, whilst in 1860, and other years, so small a quantity is noted; but it must be remembered that the rain-fall is very irregular from year to year, especially in a mountainous place such as Sierra Leone, and this remarkable difference might be traced in other parts of the world:—Thus, in Bombay in 1824, the quantity of rain-fall was 34 inches, whilst just two years previously, viz., in 1822, the quantity was more than treble that, it being 112 inches. Again, in the *Bengal Hurkaru* of September 16, 1845, we find the following, quoted by Martin:—"The *Englishman* is informed that seventy-four inches of rain fell in Arakau during the last month, and that fifty inches had fallen during the first twelve days of the present month. The whole fall during the monsoon to the 15th August, was two hundred inches." In 1835, on the 10th May, sixteen inches of rain fell in Calcutta in the brief space of twelve hours.

Register of Pluviameter from the 8th June to the 31st August 1829. Kept at Sierra Leone (Boyle).

Days.	Morning. Inches	Evening. Inches	Total. Inches.	Remarks.	Days.	Morning. Inches	Evening. Inches	Total. Inches.	Remarks.
June 8	...	1·10	1·10		July 21	...	...	...	
„ 9	1	1·10	2·10		„ 22	3·25	1	4·25	
„ 10	1	1	2		„ 23	1	1	2	
„ 11	2·20	2·20	4·40		„ 24	2·25	1	3·25	
„ 12	·10	1	1·10		„ 25	2	4·25	6·25	
„ 13	3	0	3		„ 26	1·10	...	1·10	
„ 14	1·10	1	2·10		„ 27	2	...	2	
„ 15	...	1·10	1·10		„ 28	1	2	3	
„ 16	1	2	3		„ 29	2·25	...	2·25	
„ 17	2·10	1	3·10		„ 30	2	1	3	
„ 18	3	...	3		„ 31	2	1	3	
„ 19	1·10	2	3·10	Tornado.	Aug. 1	1·25	3	4·25	
„ 20	2·75	1	3·75		„ 2	1·25	3	4·25	
„ 21	1·10	1	2·10		„ 3	3·25	1	4·25	
„ 22	1·25	1	2·25		„ 4	2	2·10	4·10	
„ 23	1·10	2	3·10		„ 5	3	1	4	
„ 24	2	2·25	4·25		„ 6	...	...	...	
„ 25	1·25	1	2·25		„ 7	2·15	...	2·15	
„ 26	1	2·25	3·25		„ 8	...	...	...	
„ 27	2	2	4		„ 9	2·10	...	2·10	
„ 28	3·25	1	4·25		„ 10	3	...	3	
„ 29	2·25	1	3·25		„ 11	3·25	...	3·25	
„ 30	1	2	3	Tornado.	„ 12	3·10	1	4·10	
July 1	3·25	1·10	4·35		„ 13	5	1	6	
„ 2	2	1	3		„ 14	3	...	3	
„ 3	1·25	2	3·25		„ 15	1·10	2	3·10	
„ 4	...	4	4		„ 16	2·25	4	6·25	
„ 5	2	3	5	Tornado.	„ 17	7	...	7	
„ 6	...	1·25	1·25		„ 18	...	...	...	
„ 7	1	3	4	Tornado.	„ 19	2·25	1	3·25	
„ 8	2·5	2	4·5		„ 20	3	1	4	
„ 9	3	3	6		„ 21	4·10	1	5·10	
„ 10	7·10	7·5	14·15		„ 22	3	7	10	
„ 11	7·5	3	10·5		„ 23	7	9	16	
„ 12	3	1	4		„ 24	6·10	2	8·10	
„ 13	2·25	2	4·25		„ 25	2·25	...	2·25	
„ 14	3·10	2	5·10		„ 26	...	3·10	3·10	
„ 15	7·5	2	9·5		„ 27	1·10	...	1·10	
„ 16	...	1	1		„ 28	1·10	...	1·10	
„ 17	...	1·25	1·25		„ 29	1	...	1	
„ 18	2·10	4	6·10		„ 30	2·10	...	2·10	
„ 19	1	1	2		„ 31	1	5	6	
„ 20	2·25	...	2·25						

The following description of the weather in August 1858, appeared in the *African*, a weekly paper published at Sierra Leone :—" The weather has been very trying lately, and a great deal of sickness is prevalent, especially among new residents. The rain has set in in right good earnest. According to the gauge kept at Fourah Bay, we find the quantity of rain which fell during the preceding three months to be as follows :—

MONTHS.	Quantity.	Remarks.
May	8·95 inches	For fifteen days of rain, with strong tornado. Thunder and lightning on 3rd, 19th, and 28th.
June	12·27 ,,	For fifteen days of rain, with strong tornado. Thunder and lightning on 4th, 7th, and 11th.
July	23·50 ,,	Nineteen days of rain.

Register of Pluviameter kept at Military Hospital, Freetown, Sierra Leone, for August, September, and October 1860.

Date. August.	Quantity in 24 Hours.	Date. Sept.	Quantity in 24 Hours.	Date. Oct.	Quantity in 24 Hours.
1	2·12 inches	1	4·27 inches	1	·10 inches
2	·64 ,,	2	·09 ,,	2	·13 ,,
3	·26 ,,	3	·65 ,,	3	·14 ,,
4	·33 ,,	4	·15 ,,	4	·50 ,,
5	...	5	...	5	·39 ,,
6	·98 ,,	6	...	6	4·65 ,,
7	2·1 ,,	7	·06 ,,	7	3·30 ,,
8	2·3 ,,	8	·10 ,,	8	·28 ,,
9	·56 ,,	9	·68 ,,	9	·25 ,,
10	·04 ,,	10	2·01 ,,	10	...
11	2·43 ,,	11	3·48 ,,	11	·36 ,,
12	1·17 ,,	12	·24 ,,	12	·23 ,,
13	1·12 ,,	13	...	13	1·11 ,,
14	·97 ,,	14	·20 ,,	14	·64 ,,
15	·06 ,,	15	1·05 ,,	15	·11 ,,
16	...	16	·52 ,,	16	·41 ,,
17	·01 ,,	17	2·14 ,,	17	·12 ,,
18	·73 ,,	18	·08 ,,	18	...
19	1·03 ,,	19	·33 ,,	19	...
20	·36 ,,	20	3·67 ,,	20	...

REGISTER OF PLUVIAMETER—*continued.*

DATE. August.	Quantity in 24 Hours.	DATE. Sept.	Quantity in 24 Hours.	DATE. Oct.	Quantity in 24 Hours.
21	...	21	...	21	...
22	...	22	3·28 inches	22	...
23	2· inches	23	·05 "	23	·10 inches
24	·84 "	24	·12 "	24	1·13 "
25	1·48 "	25	·09 "	25	...
26	...	26	·28 "	26	·86 "
27	·86 "	27	·09 "	27	·12 "
28	2·61 "	28	·61 "	28	·01 "
29	...	29	·49 "	29	·21 "
30	·02 "	30	·60 "	30	·65 "
31	1·57 "			31	...

THE FOLLOWING IS AN AVERAGE WEEKLY PLUVIAMETER FROM APRIL TO JUNE, KEPT AT SIERRA LEONE IN 1860.

No.	Week ending	Pluviameter.	No.	Week ending	Pluviameter.
1	5th April	Nil.	8	24th May	3·46 inches
2	12th April	Nil.	9	31st May	1·27 "
3	19th April	1·32 inches	10	7th June	2·5 "
4	26th April	2·24 "	11	14th June	3·2 "
5	3d May	·73 "	12	21st June	4·41 "
6	10th May	·89 "	13	28th June	5·12 "
7	17th May	3·89 "			

REGISTER OF PLUVIAMETER KEPT AT MILITARY HOSPITAL, BATHURST, RIVER GAMBIA, FOR MAY, JUNE, JULY, AUGUST, AND SEPTEMBER.

DATE. May.	Quantity in 24 Hours.	DATE. June.	Quantity in 24 Hours.	DATE. July.	Quantity in 24 Hours.	DATE. Aug.	Quantity in 24 Hours.	DATE. Sept.	Quantity in 24 Hours.
1	...	1	...	1	...	1	...	1	·20
2	...	2	...	2	...	2	...	2	·04
3	...	3	...	3	...	3	·09	3	·42
4	...	4	...	4	...	4	1·05	4	1·99
5	...	5	...	5	·41	5	...	5	...
6	...	6	...	6	·11	6	·17	6	3·26
7	...	7	...	7	·29	7	5·90	7	·69
8	...	8	...	8	·03	8	1·43	8	...
9	...	9	...	9	...	9	...	9	...
10	...	10	...	10	...	10	1·23	10	...
11	...	11	...	11	...	11	·79	11	·10
12	...	12	...	12	·67	12	...	12	...

REGISTER OF PLUVIAMETER AT BATHURST—*continued.*

DATE. May.	Quantity in 24 Hours.	DATE. June.	Quantity in 24 Hours.	DATE. July.	Quantity in 24 Hours.	DATE. Aug.	Quantity in 24 Hours.	DATE. Sept.	Quantity in 24 Hours.
13	...	13	...	13	·73	13	...	13	...
14	...	14	...	14	...	14	...	14	·05
15	...	15	...	15	...	15	...	15	...
16	...	16	...	16	...	16	·04	16	·08
17	...	17	...	17	...	17	·08	17	2·25
18	...	18	...	18	...	18	·95	18	1·91
19	...	19	...	19	·25	19	·19	19	·66
20	...	20	...	20	·17	20	2·96	20	...
21	...	21	...	21	...	21	1·03	21	...
22	...	22	...	22	...	22	·11	22	...
23	...	23	·01	23	...	23	1·52	23	1·33
24	...	24	...	24	...	24	·55	24	·37
25	...	25	...	25	·07	25	...	25	...
26	...	26	...	26	2·33	26	...	26	...
27	...	27	...	27	...	27	·05	27	...
28	...	28	...	28	·12	28	·13	28	...
29	·45	29	...	29	...	29	·80	29	...
30	...	30	...	30	1·43	30	...	30	...
31	·59	...	...	31	·13	31	·77	...	...

At the commencement and the termination of the rainy season the rain falls almost always only in the night, and, as a general rule, more rain falls at night than in the day by one-fifth. So also more rain falls on mountainous districts than on plains, and more in the neighbourhood of the sea than at sea.

At this period rainbow is of very frequent occurrence. This phenomenon is seen, when the sun is shining and a rain shower falling at the same time, as a coloured circular arch in the heavens. *Morning rainbow* appearing in the south-west, with a south-west wind blowing, indicates approaching rain; and with an easterly wind, indicates fair weather. Evening rainbow appearing in the east, with a south-west wind, indicates fair weather; but with an easterly wind, it portends approaching rain.

Rainbow, definition and prognosis of.

Descartes and Sir Isaac Newton have investigated and conclusively explained the causes of the rainbow. It is produced "by the sun's rays falling upon drops of rain near the upper surface, where, being refracted, they pass to the side of the

drop which is farthest from the sun and the spectator, whence they are reflected towards the lower surface; and on quitting the drop they suffer a second refraction. Each pencil of rays, on emerging from the drop, consists of parallel rays of light, which produce in the mind of the spectator the perception of brightness. Light is, therefore, *twice refracted* and *once reflected* within each drop of rain or vesicle of vapour," so that a rainbow is only seen when the falling rain is opposite the sun.

Hailstones and snow.

In the month of August I have frequently noticed the fall of hailstones in the mountainous district of Sierra Leone; they are generally of an inch or half an inch in size, and caused by drops of rain suddenly frozen on their passage to the earth. Snow, which is the visible aqueous vapour composing clouds in a frozen state, has also fallen in Western Africa. A writer in the *African Times,* August 1863, thus gives an account of one occurrence:—"On the morning of the 10th or 12th of May last the atmosphere was very heavy, and there were signs of the approach of a great deal of rain; a thick cloud was observed towards the east, and a cold easterly wind was blowing. This was at Swadore, near to Winnebah. It drizzled a little, and then there followed a heavy fall of snow—real condensed snow—not like hailstones, but in small icicles. The natives, as well as the European officers, were struck with astonishment. . . . This may be received as corroborative evidence of the statements of travellers in Eastern Africa, who reported that they found mountains covered with snow." This statement was true, as I saw several officers who were present when the phenomenon took place.

Lightning and thunder.

When atmospheric electricity passes between the earth and a cloud, or between two clouds, lightning is produced; and the report that is occasioned through it forms thunder. In Western Africa lightning is very dangerous, and frequent observations corroborate the statement, that it generally strikes the south-east aspect of buildings, and never the northern. When *forked* or in *sheet* its duration is only $\frac{1}{1000}$th part of a second; but when in the form of fireballs, it may last for

several seconds. In a thunder-storm the nitrogen and oxygen of the atmosphere combine suddenly, and nitric acid is the result. These storms sometimes destroy the magnetism of the needle of the compass, "and occasionally invert its magnetic poles."

At the beginning of the rainy season and the autumn several meteoric phenomena are observable in the evening—fireballs or shooting stars, flying in various directions in the atmosphere, or descending slantingly on the earth. I have many times seen the atmosphere lighted up in a most charming manner by these balls. These phenomena are connected with the stones fallen from the atmosphere described by ancient writers. They are meteoric stones or aerolites (*aër*, the air, and *lithos*, a stone); and when analysed, are found to consist of 54 parts of silica, 36 of oxide of iron, 9 of magnesia, 3 of oxide of nickel, 2 of sulphur, and 1 of lime. Shooting stars.

During this season mosquitoes and sand-flies abound in Africa, and are very troublesome. In the Gambia region both of these are very annoying; at Sierra Leone, Liberia, and the Gold Coast, less so, there being but few mosquitoes, except at the swampy mouths of rivers, and no sand-flies. In the Bights of Benin and Biafra mosquitoes are plentiful. The audacity of this insect is thus described by the late Dr Baikie, in his descent from the first Niger expedition :—"Mosquitoes crowded on board, possibly to welcome us on our return; but the pleasure of meeting was not reciprocal, nor could we persuade them to take a quiet hint and retire. I detected one settling in the most cool and impudent manner on the back of my hand, preparing to enjoy an extemporary banquet. I fancied I recognised this savage intruder as being the same which had, during our ascent, committed on me an assault to the effusion of blood; but, in the heat of my indignation, I sacrificed this sanguinary gnat without allowing time for mutual recognition, so that this question of identity must remain for ever a doubtful point in history."

CHAPTER XI.

1. HARVEST OR AUTUMN—SEPTEMBER, OCTOBER.—2. HARMATTAN OR COLD SEASON—NOVEMBER, DECEMBER, JANUARY.

The harvest or autumn is a very unhealthy season. At its commencement, in some parts of the coast, there is little or no rain, whilst in others there is plenty of it. In the regions of the trade-wind—Gambia, Senegal, and the Casamanza—there is generally very little rain in September, and scarcely any at all in October. The same is the case with the Gold Coast and the Bights; but there are very severe thunder-storms and tornadoes, and heavy gales of wind. At Sierra Leone and Liberia there is always plenty of rain in September (as may be seen from the pluviametrical register of the former place, recorded in the last chapter), and a little in October. In the Gambia region the month of October is very hot and oppressive, the atmosphere being well supplied with moisture from the drying swamps; and the heat, ranging to 100° F., is less bearable than the dry atmosphere of April

Average pluviametrical observations.

The thermometer at its maximum in the first section averages 93°; at its medium, 86°; at its minimum, 74°. In Sierra Leone and Liberia the average maximum is 84°; medium, 78°; minimum, 70°. On the Gold Coast and in the Bights, the average maximum is 83°; medium, 76°; minimum, 72°. According to Bogle, the barometer at its maximum is 30° 15′; medium, 29° 84′; and minimum, 29° 30′.

Condition of weather.

The weather now, especially at the commencement of the season, is very changeable; the rains, less frequent, sometimes descend with great rapidity and violence; at others in small, short drizzles, which are very disagreeable. Vegetation is now

in full maturity, the fruits and plants are gathered, and some of the leaves wither and fall to the ground; vegetable putrefaction takes place, stimulated both by the moisture from the sea and the heat of the sun, and becomes a fruitful source for the exhalation of malaria.

During the greater part of this section the south-west monsoon is the prevailing wind; towards the latter part of October the wind shifts from this quarter towards east and north-east, and then commences the north-east monsoon. In the region of the calms the land and sea breezes alternate, occurring at almost regular intervals.

Hurricane in clouds.

The harvest terminates in the harmattan or cold season, about the 15th November, at which time a peculiar phenomenon, which I have designated *hurricane in the clouds,* occasionally takes place. It occurs generally high in the regions of the clouds, and causes great wonder and surprise amongst novices who have only observed it for the first time. It happens at any time during the twenty-four hours, morning, noon, evening, or night, and commences with the atmosphere appearing to be perfectly stultified—everything in dead quietness—a heavy cloud concealing the heavens just over head, and appearing so solid that it might fall in one heavy mass. A rumbling noise now commences, low at first, but gradually becoming loud, very different from that of thunder, but resembling, in a most marked degree, the noise of a paddle-steamer, or that of a railway carriage whilst passing through a tunnel. This brings out all the inhabitants who are within doors, and is caused by electricity passing suddenly between the strata of clouds and meeting with some disturbance; the rumbling is followed by loud detonating sounds, as if a powerful Leyden jar encompassing the whole atmosphere was being discharged, and the whole atmosphere becomes highly charged with electricity. This continues for about ten minutes, when a few heavy drops of rain fall, the wind gradually begins to rise from south-west, dispersing the clouds, and the atmosphere becomes as natural as before. So like, indeed, is this electric disturbance to the

paddling of a steamboat, that I was entirely deceived when first I heard it at M'Carthy's Island, at about three o'clock in the morning, and was under the impression that the colonial river steamer had arrived in port. The natives interpret this as the termination of all rains for some months, and true enough, after occurring twice or thrice, no rain ever falls for six or seven months.

Harmattan or Cold Season.

General observations.

This season commences about the middle of November and terminates in the middle of February, occupying a period of three months. The name harmattan is derived from the Fantee *aharamanta,* a designation of the season when this wind blows, from *aharaman,* to blow, and *ta,* tallow or grease; since at this season the weather is so dry and parching that the inhabitants are obliged to keep their skin soft and moist by the use of grease. It blows along the whole Western Coast of Africa, extending from Cape de Verde, in lat. 15° N., and Cape Lopez, in lat. 0° 36′ 10″, S. and long. 8° 40′ E. Its intensity decreases as we leave the Gambia region to leeward. In Senegal, Gambia, and Casamanza it blows from E. and N.E., in Sierra Leone from E.S.E., on the Gold Coast from N.E., and at Lopez from N.N.E.

Description of harmattan.

The approach of the harmattan is generally indicated by the dropping of the leaves of trees, which do not putrefy as in the preceding season, but are dried up, so that they are prevented from being the source of malaria. Vegetation of every kind is affected; all the tender plants, and most of the productions of the garden, are destroyed; the grass withers and becomes dry like hay; vigorous evergreens suffer from its pernicious influence; "branches of the lemon, orange, and lime trees droop; the leaves become flaccid, and so parched as to be easily rubbed to dust between the fingers, should the harmattan blow for several successive days." It is generally accompanied by a thick fog or mist, extending out at sea in some cases to three leagues, which Baron Roussin considers to be sand in extreme fineness, and not inaptly compared with

the characteristic London fog, differing, however, from it in its physical effect on the system. An idea of the nature of the fog may be obtained from the fact, that in the height of this season the sun at near noon might occasionally be seen through the fog as white as the moon.

One great peculiarity of this wind is that of extreme dryness. All nature seems to feel this effect. The ground is dry, parched, and cracked in various places; the grass withers, trees lose their green foliage; chinks are opened in the roofs of houses; the doors and windows become dried up, forcibly split, and cannot properly fit; the furniture made of the most seasoned wood loosens, warps, and cracks audibly; books bend concavely; wine-glasses or tumblers forcibly crack on the sideboard without the application of any violence. In the human body it produces great dryness of the throat, a sensation of thirst, which is to relieve the parched or dried up pharynx; the lips are chapped, and bleed occasionally; the surface of the body crisps, and the whole system suffers from great uneasiness. So early as in 1796, Mungo Park, the great African traveller, thus speaks of the harmattan wind :—"After the rains the wind sets in from the north-east and produces a wonderful change in the face of the country. The grass soon becomes dry and withered; the rivers subside very rapidly, and many of the trees shed their leaves. About this period is commonly felt the harmattan, a dry parching wind, blowing from the north-east, and accompanied by a thick smoky haze, through which the sun appears of a dull-red colour. This wind, in passing over the great desert of Sahara, acquires a strong attraction for humidity, and parches up everything exposed to its current. It is, however, reckoned very salutary, particularly to Europeans, who generally recover their health during its continuance. I experienced immediate relief from sickness, both at Dr Laidley's and at Kamadia during the harmattan. Indeed, the air during the rainy season is so loaded with moisture, that clothes, shoes, trunks, and everything that is not close to the fire, become damp and mouldy, and the inhabitants may be

said to live in a sort of vapour-bath; but this dry wind braces up the solids which were before relaxed, gives a cheerful flow of spirits, and is even pleasant to respiration. Its ill effects are, that it produces chaps in the lips and afflicts many of the natives with sore eyes."

Origin and cause of harmattan.

I have sought in vain, from a great many English and French treatises on the harmattan wind, for an account of the origin of this strange wind. Every one agrees that it is from the desert, but the proximate cause seems not as yet to have been discovered. To me it appears that its origin may be traced to the following causes. A large portion of the sandy desert of Sahara is within the tropics, and this sand has a special attraction for the sun. During the months of July, August, and September, little or no rain falls on it, it being within the region where the trade-wind is more or less constant. Towards the end of September, and during the whole of October, and sometimes the beginning of November, the atmosphere is hot and sultry, the heat oppressive, and the thermometer in some days rises beyond 100° F. even in the West Coast towns. In the sandy desert the heat is excessive; the sand becomes perfectly dry and parched.

This sultry and heated period lasts until the end of October, when the wind shifts from the west, south-west, or north-west, towards east, north-east, or south-east, just as the winter or cold portion of autumn commences in the temperate zone. The cold winterly air travels exceedingly fast from the poles towards the equator to replace its heated sultry air, which rapidly ascends. On passing through the sandy desert the cold winterly air is deprived of its moisture by the parched up sand, so that it arrives towards the coast on lands beyond the desert as a cold, dry, parching wind. In the northern portion the cold air blows for days continuously, and then shifts for a time to allow a heating process to take place. The air becomes heated, another rush takes place, and so it continues, alternating irregularly, until towards the close of the winter, when the air from the temperate and polar zones becomes warmed as it

traverses Southern Europe before passing over the desert, where it receives additional heat, and arrives on the coast as a hot wind.

The cold atmosphere of the harmattan is, in reality, the cold winterly air of the temperate zone passing rapidly into the tropics, slightly modified by local causes. The dry, parching character is acquired whilst passing through the desert of Sahara, the sands of which, yawning for moisture, quickly deprive it of its humidity, and thus we have it as a cold, dry atmosphere. The haze or fog, as Roussin has remarked, is obtained from the light sand of the desert wafted away by the cold breeze as it passes through it in fierce velocity to replace the heated air of the coast. All those places which lie on the west and south-west of the desert receive the harmattan wind more or less constantly and regularly for three months in the year, as it is in Senegal, the Gambia, and Casamanza, and their interior countries; those south, or bordering on the south, more sparingly, as in Pongas, Nunez, Sierra Leone, and a part of Liberia; and those having but small connection with, and a great distance from it, have the wind occasionally and very sparingly, and their only chance of getting it at all depends entirely on physical causes, as on the Gold Coast and in the Bights. The light sand detached from the desert is carried to the regions where the wind blows, where it deposits a part as it goes along, and places where it continually blows receive more, and places where it sparingly blows receive less. The cold dry air abstracts from vegetation, from the surface of the earth, from the bodies of man and beast, and from all material substances, all the moisture that it possibly can get, and, consequently, at this season, as we have before said, the ground is parched and dry, the leaves of trees wither and fall, the frames of houses become loose, dry, and cracked, and a dry sensation felt.

During the blowing of the harmattan wind, the temperature of the atmosphere is more dry even than at any other period of the year, especially in the Gambia region. The variation which at other seasons ranges between 20° to 40°, is now re- Variation in temperature.

duced to only 7° in some days. This is when the harmattan breeze blows during the whole of the twenty-four hours. Sometimes it blows only in the morning, and then shifts to south-east, when the wind becomes hot in the afternoon, at which time the range of temperature becomes very great.

The thermometer at its maximum in the Gambia region averages 90°; medium, 86°; minimum, 64°: Sierra Leone and Liberia, maximum, 83°; medium, 78°; minimum, 76°: Gold Coast and Bights, maximum, 82·10°; medium, 79°; minimum, 76·5°. During the blowing of the harmattan wind the barometer rises to 31 inches, and keeps there for days, and then gradually falls until it assumes its normal standard.

It must be understood that the harmattan wind does not blow continuously during the whole of the season, but only for some days. In the intermediate days, in the *zone of calms*, the regular interchange of land and sea breezes takes place. In the *zone of the trade-winds* an easterly or south-easterly wind blows. It is sometimes so strong that the atmosphere, which is very hot outside, is very cold indoors, from the constant change in the general sentient surface. The wind is so strong that the dust flies about in every direction, and whirlwinds are frequent in squares. This wind does not produce that curvature of books and depredation to furniture which is the characteristic feature of the winds of the season. This easterly wind is very unhealthy, and when it blows individuals generally complain of uncomfortable feverish sensations, as well as of disease of the internal secreting organs.

Effects on insensible perspiration.

During the blowing of the harmattan wind insensible perspiration is not entirely destroyed, for frequently on rubbing the forehead the surface is felt to be rough and gritty, and on removal small crystals are found at the end of the fingers. These consist of the salts which form the solids of the sudoriferous secretions, and are composed principally of chlorides of sodium and potassium. The cold, dry harmattan wind dries up the watery constituents of the perspiration so quickly that the salts become at once deposited.

MEDICAL CLIMATE OF WESTERN AFRICA.

CHAPTER XII.

1. GENERAL OBSERVATIONS.—2. DISEASES OF THE HOT SEASON.

"WHOEVER," says Hippocrates, "would investigate medicine properly, and practise it successfully, should first consider the seasons of the year and their different effects; the winds common to all countries, and those peculiar to each locality; the aspect of towns and cities in relation to the winds and rising of the sun; whether the ground be naked and deficient in water, or wooded and well watered; and whether situated in a hollow, confined locality, or on an elevated and cold site." These were the principles that guided the practice of ancient physicians, and this shows that in those days they not only considered the importance of sanitary reform, and the necessity of sanitary measures for the improvement of the health of the inhabitants of towns and cities, but that they advocated their adoption.

We have in the preceding chapters entered fully into the physical state of the different stations in Western Africa, their sanitary conditions, as well as the seasons which govern their various effects on health; and as Arbuthnot has justly remarked, each season has its special disease, which is the result of fixed physical or chemical laws, and not as a matter of accident, so that it will be my province to bring into prominent notice the diseases peculiar to each of the seasons

into which the climate of the West Coast of Africa has been divided.

Proneness of Europeans to disease in the tropics.

When we consider the proneness of Europeans to disease in intertropical Africa, and the yearly waste of life which is occasioned by increase of that class of population, without increased sanitary improvement, we are of opinion that great advantages would result, were the authorities to make it a point to ascertain what races of men are best fitted to inhabit and develop the resources of the different colonies, and the limits within which they could properly thrive and increase.

M. Budin's statistics.

M. Budin has giving the following "statistics of the sanitary condition and mortality of forces by land and sea, as influenced by season, localities, age, race, and national characters," quoted by Martin. He considers that—

1. The losses of armies from disease greatly exceed those in time of war from the sword and fire of the enemy. In the Walcheren expedition in 1809, the mortality of the English army amounted to 16·7 deaths by wounds, and 332 by diseases per 1000 of the strength.

2. The most trifling losses are experienced in general by troops serving in their native country, and they augment in European armies in a direct ratio as these approach the equator. The inverse takes place with negro troops, among whom mortality increases obviously in the direct ratio of their removal from the tropics.

3. Even during a residence in their native country, European armies are subject to a mortality exceeding, in a sensible manner, that of the civil population at a corresponding age. In certain tropical countries, Sierra Leone for example, the mortality of the soldiers (483 deaths per 1000) surpasses the proportion of deaths, which occurs in England among the male population, at the age of 100 and upwards (454 per 1000).

4. In localities bordering closely upon each other, the mortality often differs in a very marked degree. This ought to be seriously considered in the selection of military stations and

places for garrisons, as well as in the choice of sites for barracks and hospitals.

5. In tropical regions the annual number of deaths ranges within very wide limits from one year to another, so that the mortality of a single year cannot seem as a basis for estimating the mean mortality of these countries.

6. In the most unhealthy tropical climates the judicious choice of good positions on elevated grounds will often secure to armies—composed of men of the Caucasian race—a perfectly healthy condition, worthy of the most favoured regions of temperate climes. The degree of elevation required varies in a marked manner with the geographical latitude and longitude of the place. Residence on the high grounds is fatal to negro troops.

7. The geological nature of the soil exerts a decided influence, not only on the sanitary condition and mortality of armies, but also on the presence or absence of certain defects which render a man unfit for military service.

8. The increase of the mortality of armies, especially in warm climates, is determined in a great measure by the marshy character of the localities occupied.

9. The mortality of the army in the different quarters of the world considerably exceeds that of the navy.

10. In the temperate regions of Europe, the density of the population in garrison towns tends to affect the sanitary condition, and augment the mortality of the troops. The relative density of the population of the different quarters and streets of a large town should be seriously considered in selecting sites for barracks and hospitals.

11. Numerous facts militate against the hypothesis of a progressive amelioration in the sanitary condition of European troops in warm climates in general, and particularly in tropical regions, as an effect of length of residence.

12. In a military point of view, the knowledge of the pathogenic march of the seasons in different parts of the globe, and of the relation of the sanitary condition of armies with the

different meteorological influences, is of immense interest, and has not yet received the attention it deserves.

13. The pathogenic influence of the seasons is in a strict dependence upon the quality of the soil, the latitude, longitude, and elevation of the places, their position in the northern and southern hemispheres, and the nationality and race of the soldier.

14. In all countries where the influence of age has been studied, the lowest mortality has been found to be that of soldiers from eighteen to twenty years of age.

15. Nationality and race favour or neutralise the pathogenic action of climate, so that, under precisely similar circumstances, troops of different races and nations may suffer and die in different proportions, and of different diseases.

Diseases of the Hot Season.

Animal heat in the tropics.

The hot season of Western Africa comprises the months of February, March, April, October, and November. During this period the heat of the sun is excessive in some places, and in others it is only moderated by the sea breeze; the animal heat, which in cold climates averages only 98°, increases from 2°·7 to 3°·6. This determines the fluids of the body towards the surface. There is a diminution of the number and depth of the inspirations—a diminution of the quantity of oxygen inspired, as well as in the percentage of carbonic acid expired; the blood becomes venalised; the biliary secretion increases; the urine contains a larger quantity of saline matter. The cutaneous surface is called upon to show increased activity, and to perform vicarious duties, thus relieving the blood of the carbon which the rarefied air prevents the lungs from removing. The increase of this animal heat is considered to be dependent, to a certain extent, "on the more rapid circulation and metamorphosis of the blood." The hot weather exercises at first a stimulating, and then a sedative and depressing effect on the great nervous centres.

Effects.

"The hot season," writes Sir R. Martin, "swells the exterior,

and produces that general chubbiness of appearance which is so remarkable in the torrid zone, even where the weight of the body is sensibly diminished. It increases the animal heat, and accelerates the pulse, accompanied by a prodigious increase of the pulmonary and cutaneous transudations. It produces nervous excitability varying in degree in most persons—an exaltation of the general sensibility; eruptive diseases, latent during the cold season, become actively developed; and the cutaneous vessels even in healthy persons are excited to the extent of producing the distressing eczema solare, known in the tropics by the name of prickly heat.

"Undue exposure, excessive fatigue, mental depression, or neglect of temperance in diet, result in ardent fever, with some serious local determination, and that very frequently to the cerebral organs, occasionally to the liver. But though this is admitted, under the measures of precaution, dictated by common sense and experience, the very hottest are yet the healthiest of our seasons, and of our stations also, which goes far to prove that it is not heat alone that does all the mischief, but something else in the climate, and in the constitution and habit of the stranger European, not common to the native of the country."

Diarrhœa and dysentery in the tropics.

During this period of the year there are many cases of diarrhœa and dysentery, and proportionally more so in places such as the Gold Coast, where water is scarce, and the people live on tank or muddy swamp water; or in St Mary's and its neighbourhood, where the well water is very brackish; or at Lagos, on the deltas of the Niger, where the water at this season is highly impregnated with animal and vegetable matter. In places where good and pure water is plentifully provided they are not common, but form only occasional diseases. At M'Carthy's Island, and in the countries interior of the Gambia region, the month of October is the most unhealthy of this season, the atmosphere is hot and moist, and the effect of the heat on the soil is like living in an atmosphere of steam.

Dysentery and diarrhœa of the most fatal kind are of frequent occurrence; virulent types of fever are very prevalent and deadly. It is the worst month of this season.

The months of February, March, and April, although the hottest in the year, especially in the Gambia region, are the most healthy. The heat is only uncomfortable, and produces great laxity of the constitution, yet it is the most healthy period; there is scarcely any record of deaths, especially in the interior countries, where the ground is parched and dried up, and no swamp is anywhere to be seen. It is the ground-nut season, and the time at which each merchant performs a great deal of labour, and yet there is scarcely any case of fever, dysentery, or diarrhœa; there may be now and then a little derangement of the liver, but otherwise there is very little necessity for a doctor. At M'Carthy's Island, where I acted as physician to the natives, the dispensary was generally crowded during the whole of the year, commencing in June, until the hot winds began to blow, when there was scarcely a case in for months. This proves without a doubt that the higher the temperature, unmixed with humidity, the more healthy is the climate; but if the temperature is high and surcharged with moisture, the climate becomes very deadly.

At Sierra Leone, Liberia, the Gold Coast, and Bights, the weather not being so hot, and being mixed with moisture from their close proximity to the sea, the season is not so very healthy as in the Gambia region, although in the two former places it is comparatively so; and in the latter places the inhabitants suffer much from diarrhœa and dysentery.

Medical statistics of Anamaboe.

The following is the medical statistical report of the Anamaboe station (Gold Coast), forwarded by me to the civil authorities whilst acting as physician to the natives in 1861:—

"During the quarter ending the 31st March there were no less than 920 patients in daily attendance in the dispensary for medical aid. These present heterogeneous diseases, which, for the sake of convenience, I have classified under four great divisions, viz.:—

I. Zymotic Diseases.

II. Constitutional Diseases.

III. Local Diseases.

IV. Violence and Accidents.

" The number of zymotic cases treated were 503 : there were three very common diseases, viz., ophthalmia, numbering 98 ; rheumatism, 89 ; and gonorrhœa, 50. Of the constitutional diseases there were 78 treated : the most frequent was debility, numbering 38. There were 312 cases of local diseases : the most frequent being constipatio, 58 ; and ulcers, 47. Of violence and accidents there were only 27 cases.

" The average daily number receiving relief from the dispensary for the quarter ending March 31st, less 16 days of illness, was 12·29.

" The following is the number of cases treated by *daily attendance* in the dispensary *in extensio* :—

" Zymotic Diseases.—Ophthalmia, 98 ; dysenteria, chronica and acuta, 30 ; diarrhœa, 12.; febris intermittens, 32 ; hemicrania, 20 ; rheumatisma, 89 ; syphilis secondaria, 1 ; bubo, 15 ; gonorrhœa, 50 ; orcheitis, 40 ; stricturæ urethræ, 12 ; chancræ, 3 ; scabies, 20 ; dysmenorrhagia, 20 ; menorrhagia, 38 ; amenorrhœa, 5 ; elephantiasis Græcorum, 6 ; dermaphyta, 15 ; dracunculus, 5.

" Constitutional Diseases.—Debility, 38 ; aphthæ, 14 ; yaws, 5 ; phthisis pulmonalis, 6 ; anæmia, 10 ; anasarca from renal disease, 5.

" Local Diseases.—Otitis, 20 ; pericarditis, 8 ; influenza, 3 ; bronchitis, 18 ; gastritis, 3 ; enteritis, 9 ; dyspepsia, 3 ; hernia strangulata, 8 ; hydrocele, 25 ; hæmorrhoides, 8 ; constipatio, 58 ; arthritis, 26 ; bursitis, 30 ; odontalgia, 9 ; tumours, 18 ; sphacelus, 2 ; cataract, 2 ; psoriasis, 12 ; eczema, 3 ; ulcers, 47.

" Violence and Accidents.—Vulnus incisus, 3 ; contusio, 24. In the foregoing are stated the daily number treated, but not the daily number of new cases treated."

The places where dysentery and diarrhœa are most prevalent in Western Africa, are at Accra and the Bight of Benin,

principally Badagry and Lagos. In the month of October, in M'Carthy's Island, and St Mary's at Sierra Leone, and Liberia, diarrhœa and dysentery are of occasional occurrence during the commencement of the rains, from the water being contaminated with dead animal and vegetable matters which are washed down into it, but they are only occasional diseases in these places.

Lightning, thunder, and electricity.

The air during this period, especially from Sierra Leone to the leeward coast, is highly charged with electricity; lightning vivid and of long duration, and distant roars of thunder, are frequent and constant. These fill the atmosphere with increased quantities of ozone, which, as I shall hereafter prove, possess considerable influence in checking the manifestation of fever. It is now a well-known fact, that the best time for Europeans to arrive on the coast so as to be exempt, at least for a time, from fever is in November. This rule is strictly observed by the Gambia merchants and the Church Missionary Society.

In November, on the coasts leeward of the Gambia, viz., from Sierra Leone to the Bights, we have the acme of thunderstorms, which are generally accompanied by fearful flashes of lightning, thus filling the atmosphere with large quantities of electricity.

The following are the observations of M. Pallas, of the French Army in Algeria, as to the effects of electricity in health and diseases (Martin):—

" 1. That just as light and air are the essential agents of vision and respiration, so electricity is the functional agent of innervation.

" 2. That the greater number of diseases, and especially those which belong to the class of neurosis, are occasioned by the exaggerated influence of general electricity, of which clouds, storms, and marshy regions are the most fruitful sources.

" 3. Marshes in their geological constitution ,and in the effects which they produce upon the economy, present the greatest analogy to the galvanic pile. Thus their action is much the more baneful, as they contain certain proportions of

water, and their activity is considerably increased when the water contains organic or saline matter in a state of solution. This explains why salt marshes, and such as are near marantine rivers, are the most insalubrious. The drying up or submersion of marshes produces analogous conditions to those of a galvanic pile deprived of humidity, or which is under water, and the effects of which are then insignificant.

"4. The researches of philosophers and physiologists have shown that the electricity produced by our machines exerts a special action upon the nervous system. Experience and vigorous observations of facts prove that the diseases which are produced by marshy atmospheres are primarily nervous, and become inflammatory only by the reaction of the nerves upon the vascular system, inducing consecutive, local, or general irritation."

The neuroseo are occasioned generally by the effects of electricity, and intermittent fevers have a similar origin; that is to say, they are due to the electrical emanations of the marshy pile, which are very active in hot countries, and not to miasmata, which have never been met with.

Perspiration in tropics.

I have before stated that in tropical climates the temperature of the body rises from 2° to 3½° beyond its natural temperate standard, but this increase does not go on in any proportion to the increase of the atmospheric temperature. When this is 90° or 112° in shade, the temperature of the animal heat is about the same, and this superabundance, which might accumulate through the increased heat of the surrounding medium, the all-wise Creator has supplied animate beings with an apparatus for carrying off. The great sweat glands remove from the system, by means of the perspiration, all excess of heat. "To obtain an estimate of the length of tube of the perspiratory system of the whole surface of the body, 2800 may be taken as a fair average of the number of pores in the square inch, and 700, consequently, of the number of inches in length. Now, *the number of square inches of surface in a man of ordinary height and bulk, is* 2500; *the number of pores therefore* 7,000,000,

and the number of inches of perspiratory tube, 1,750,000—*that is,* 145,833 *feet, or* 48,600 *yards, or nearly twenty-eight miles.*" This is a most important calculation, and shows what mischief to the system will be the result when the functions of such an extensive surface are obstructed.

The perspiration, therefore, is the great regulator and moderator of the internal heat of the body. Through it, an individual can live in the hottest weather; and by the power inherent in him of generating heat, he is able to live in the coldest clime. Mr Erasmus Wilson, in his "Treatise on the Skin," has most truly stated that man can support the intense heat of the tropics without much elevation of his inward heat, and that he can live where the mercury is rendered a solid mass like lead, by cold, without the most trifling depression of his vital warmth. "But," writes he, "it must not be supposed that the constitution of man is the same in these two opposite conditions; it is, indeed, widely different; in the one he enjoys what may be termed a *summer constitution;* in the other a *winter constitution*—the first harmonising with the summer heat, the second resisting the winter cold.

Prickly heat.

At this time of the year *priekly heat* is found to be very troublesome, especially amongst new comers—the red pimples or eruptions appearing in the breast, arms, neck, and sometimes all over the body, producing the most disagreeable and annoying sensation which none can understand except those who have suffered from it. It is, however, a sign of good health, and there is no remedy as yet that could be regarded as specific. Cold and acid lotions, lime juice, sulphuric acid lotion, cold baths, cooling drinks, have all been used, but in vain. The only remedies are palliative, consisting of "light clothing, temperance in eating and drinking, avoidance of all exercise in the heat of the day, open bowels," and the use of a large fan at night.

Physical effects of hot climate.

Sir R. Martin gives the following able summary of the physical effects of hot climate on the human economy:—

"The air being expanded, less oxygen is taken in at each

respiration. The necessity for hydrocarbonaceous food is therefore lessened. Less of the 'elements of respiration' ought to be taken in the food than would be taken in colder climates. In consequence of the internal increase of temperature, less internal heat is required.

"Exercise increases the heat of the body by increasing the rate of circulation and respiration. In a very hot climate all increase of heat is undesirable. Moreover, the excessive heat renders muscular action impossible, because the circulation is chiefly directed, in consequence of the activity of the skin, to the surface, in order that fluid may be furnished for evaporation, to keep down the heat of the body, to prevent the parching of the surface which otherwise must ensue.

"In consequence of the lessened muscular action, less of the albuminous constituents of the food are required to supply the waste of the muscles.

"Hence, in hot climates, less of both kinds of food should be taken, and nature points this out in the absence of appetite. To force an appetite stimulants are taken, and then the system is overloaded with nourishment. The excessive perspiration requires an excess of liquids; but instead of water alone, sugar and spirit—the elements of respiration—are taken with the water as beer; and the spirit, by its stimulating properties, is doubly injurious.

"The excessive flow of blood to the surface (the consequence of the high temperature), no doubt prevents, for a time, the evils resulting from an excess of the two kinds of food. The chemical changes and evaporation going on in the skin draw the circulation to the surface of the body, just as the flame of the lamp draws the oil up the wick. Whilst the high temperature lasts, this increased action of a flow to the surface is kept up. It is probable that the action of the heart is thereby made feeble by the excessive suction of the skin, as we see it frequently is, temporarily, by the perspiration bath. As soon as the temperature falls, the blood ceases to flow in excess through the skin. According to the degree of cold it is

almost driven from the surface. It accumulates within, and congestions and inflammations are produced. Free action on the inner surface of the body for a time relieves the congestions, and enables the circulation to proceed."—Martin on *The Influence of Tropical Climates.*

CHAPTER XIII.

DISEASES OF THE RAINY SEASON.

Unhealthiness.

WITHIN this range we meet with the most unhealthy period of the tropical year, the commencement of the rains and its termination; and sometimes from meteoric causes, during the whole of the rains, fevers of the most severe type are prevalent. The temperature at the commencement of the rains falls a great deal; the occasional showers produce a refreshing and delightful feeling; the atmosphere becomes very moist and warm; vegetable and animal life, which before were in a state of dormant vitality, now put on renewed life and vigour; decomposition of animal and vegetable matter, accelerated by the heat and moisture, is very rapid. The atmosphere is very heavy in the mornings and evenings, and the horizon is covered with fog and haze. When the heat of the sun is felt, it produces a great increase in the perspiration, which through the moist air seems to exude from the various pores of the body by transudation, and not by evaporation. The muscular system becomes very much relaxed, the action of the heart weak; there is a congestive state of the internal organs through the venalised condition of the blood, and its receding from the surface.

When the rains have not been plentiful at the commencement, only coming occasionally, and being succeeded by very hot days, when there has not been much thunder and lightning before and during its commencement, fever of the most relaxing and congestive character, or epidemics of yellow fever,

are generally the consequence. Dysentery and diarrhœa are also prevalent in places where good water cannot be obtained. In Western Africa the commencement of the rains is more unhealthy than their termination, although this period is generally very sickly.

There are many circumstances which combine to render the season unhealthy—

Circumstances producing unhealthiness.

1. The occasional occurrence of rain, with the subsequent heat, leads to the formation of stagnant pools, rich in vegetable and animal putrescent matter.

2. The clearing of the fields by farmers in preparation for sowing, deprives the country of the salutary effects of vegetable life, in absorbing the poisons of malarious effluvia emanating from stagnant pools and other sources.

3. The diminished vitality of all the functions of the body; and,

4. The great want of electric agencies in the atmosphere (thunder and lightning), and the consequent diminution of nature's universal disinfectant—*ozone*.

Medico-statistical report.

To prove that the commencement of this season is even more unhealthy to the native population, I shall here quote at length my medico-statistical report of Anamaboe station, from 1st April to 20th May 1861, forwarded to the civil authorities:—

The numerical relations between sickness and health during the half section of the second quarter of the year, form an interesting data for inquiring into the relative healthiness or unhealthiness of the different sections of the year.

From meteoric circumstances, as well as practical observations, it is now universally acknowledged that the second quarter of the tropical year is the most unhealthy part of the year.

During the first quarter of the year the number of daily patients attending the dispensary to the 31st of March, amounted to 920; whilst during the half section of the second quarter, viz., from 1st April to 20th May (scarcely two months), the number of daily patients was 1114.

The average daily number of patients who attended the dispensary for the first quarter was 12·2, whilst for the sectional part of the second quarter it was 22·2, showing an increase of 10 per cent of daily attendance. From these facts alone it is evident, that at this quarter of the year the station under consideration was far more unhealthy than the preceding.

I shall now enter into detail respecting the different diseases treated, and shall follow the division I had formerly adopted, viz.:—

I. Zymotic.
II. Constitutional.
III. Local.
IV. Violence and Accidents.

There were no less than 566 cases of zymotic diseases daily treated. The most frequent were—rheumatism, 116; and gonorrhœa, 100. It is remarkable that the number of dysenteric cases was fewer than was expected for the time of the year; this may be accounted for from the fact, that the natives possess potent medicines for it, and, except in extreme cases, they do not apply to the dispensary; so also with fever.

There were 83 cases of constitutional diseases; and 386 of local diseases, of which ulcers (100) were the most frequent; violence and accidents numbered 79 cases.

I shall now conclude by stating, *seriatim*, the number of daily cases treated in the dispensary, as well as those daily treated in the houses of Poll Tax patients.

I. Zymotic.—Ophthalmia, 60; diarrhœa, 12; dysenteria, chronica and acuta, 30; febris intermittens, 22; hemicrania, 6; rheumatisma, 116; gonorrhœa, 100; strictura urethræ, 40; scabies, 42; dysmenorrhagia, 60; porrigo, 18; orcheitis, 60.

II. Constitutional.—Debility, 45; phthisis pulmonalis, 10; scrofula, 28.

III. Local.—Hemiplegia, with spasmodic contraction, 60; otitis, 26; bronchitis, 54; pneumonia, 18; dyspepsia, 6; constipatio, 85; odontalgia, 10; psoriasis, 8; ulcers, 100; pediculæ, 8; hydrocele, 9.

IV. Violence and Accidents.—Vulnus incisum, 30; contusio, 24; fractura, 12; snake bites, 13.

The unhealthy season commences later in the Gambia region than on any other part of the coast, as the commencement of the rains is later. The sickly weather begins about the end of June and during July. At Sierra Leone and Liberia the rains commence early in May, and the sickness then begins to manifest itself; and it is a known fact, that the report of epidemic is generally heard of one or two months at Sierra Leone ere it is heard of in the Gambia. On the Gold Coast station the commencement of the rains is not so unhealthy, from the exposed state of the different stations to the constant sea breeze and the perfect ventilation which is the result. Lagos and other parts in the Bights, not being so mnch exposed as the Gold Coast, are very unhealthy.

Ozone—its effects on malarious fever.

One of the causes of the unhealthiness of the beginning of the rains is the diminution of atmospheric ozone. The effect of this important agent in malarious fever has occupied my particular attention. Being stationed for some time in the hot-beds of malaria, I had ample opportunities of observing the various changes which take place in the system when under the operation of both.

The quantity of ozone in the atmosphere has an indisputable effect on the influence of fever in malarious districts; when it exists in large quantities cases of fever are generally few, and when in small quantities, fever is more frequent and of longer duration.

When the quantity of ozone in the atmosphere is very large, one may with impunity expose himself, in places where malaria is rife, without the manifestation of its constitutional effect for days or even weeks; and although a large quantity of ozone in the air destroys evidently a large quantity of the substance we know as the harbinger of fever, itself, at the same time, undergoing decomposition and destruction, yet still that which remains may be inhaled in sufficient quantity to lead to a paroxysm, although prevented from manifesting

itself by the powerful influence of ozone, which is taken into the system by respiration and impression on the exposed sentient surface.

It would appear that the quantity of ozone taken into the lungs, or the quantity taken into the system, in an undecomposed state, is insufficient to neutralise, or destroy *in toto,* the quantity of malaria accumulated in the system. When the latter is in large quantity, it can only prevent it from manifesting its paroxysmal phenomena. Two cases which I carefully watched will be sufficient to illustrate the opinion above stated. An officer who lived with me in the same fort was very fond of sporting. During the latter end of April 1860 he was accustomed to go out shooting every morning in the marshy swamp along the banks of the lagoon, in the Bight of Benin, but he was never ill. The quantity of ozone in the atmosphere was very large, ranging, at an average—the maximum during day, 8°; minimum, 1°; during the night, maximum, 9°·2; minimum, 2°. When the quantity diminished, which it did in the middle of May, none being detected on some days, the maximum average in the day was 1°; minimum, 0°·2; in the night, maximum, 5°·5; minimum, 0°·4. Without at all exposing himself, he had a severe attack of remittent fever, which was only cured after a large quantity of quinine had been administered; and without a subsequent exposure, he had a fit regularly every two weeks as severe as the first, and to put a stop to its mischievous effects on the system, I ordered quinine to be taken a day before the end of the two weeks, or the expected day of the attack, which had the desired effect of preventing its recurrence.

The other case is my own, occurring during the latter part of June of the same year. I was accustomed every evening to go out shooting on the marshy banks of the lagoon, and was perfectly free from any attack of fever, although from the small quantity of rain which fell, and the unusual burning heat of the sun, I was perfectly certain that a large quantity of malaria was being generated from these sources. The quantity of

ozone in the atmosphere was then very large, being, during the day, maximum, 10°; minimum, 1°; and during the night, maximum, 8°; minimum, 3°. I desisted from the expedition from having no small shot, and used then to take my walks on the shores of the Atlantic, and consequently beyond the reaeh of malaria. But a week after, when the ozonometer fell, the feverish symptoms began, producing entire loss of sleep, with severe headache, and continued for three days, but were subdued on the fourth day. The quantity of quinine taken was comparatively small, being only six grains. A week after I had another attack, but three hours later than the first. I now, however, took the precaution of taking quinine on the morning of the next Saturday, and similarly for some time, until I was perfectly free from fever. Other like cases might be cited, all tending to prove more or less the point in question. Sometimes the quantity of malaria taken into the system is so great that the small quantity of ozone absorbed is not sufficient to keep it in cheek, and in such a case the effeet quickly manifests itself.

When there is a large quantity of ozone in the atmosphere, a small quantity of quinine alone is sufficiently requisite to check malarious fevers. Six grains are sufficient in an ordinary case; but when the quantity of ozone is small, more than double that quantity will be insufficient, and, indeed, in many such cases I have been obliged to give from fifteen to twenty-four grains before I could check its progress.

The conclusions to be deduced from the foregoing are:—

1. That the larger the amount of ozone in the atmosphere, the smaller will be the number of malarious fevers prevalent or manifesting themselves; on the contrary, the smaller the quantity of ozone the greater and more fatal will be the number of cases of fever amongst the population, *cæteris paribus*.

2. The quantity of ozone in the atmosphere, even when large, does not neutralise the whole of the malaria generated from the different beds scattered on the earth's surface, but a certain quantity is always left, which is absorbed and aceumu-

lated in the system until a quantity is received sufficient to overbalance the vital changes in the different essential organs, or the proper motion of the sympathetic action, leading to the development of the fever.

3. That in cases where there is a large quantity of ozone in the atmosphere, the quantity received and absorbed through the lungs and the general surface into the system undecomposed, aided by the chemico-vital changes, is able to check the manifestation of its influence, but not entirely to annihilate it.

4. That when the quantity of atmospheric ozone is small, and consequently a small quantity, or none at all, is absorbed into the system, the chemico-vital changes being no longer able alone to prevent the manifestation of the poison, the fever bursts forth in full vigour.

Chemistry has not as yet supplied us with the means of collecting and preserving ozone to any length of time. Being a powerful oxidising agent, its formation is easily followed by its decomposition or deoxidation; and when the chemist will tell the physician that he has found a method by which he can not only form a large quantity of ozone, but preserve it for a considerable time undecomposed, the physician will say that he has at his command a powerful means for checking the progress of malarious fever far superior to that of quinine.

From noticing the effects of small quantities of ozone in the air on patients suffering from fever in malarious districts, I am led to conclude, that should the chemical experiments succeed, we shall be able to cure endemic fever as soon as the symptoms begin to manifest themselves, and the system will be freed from the tedious and exhausting process of cold and sweating stages.

Although the quantity of ozone in the atmosphere may be small when compared with the constituents of the air, being, under ordinary circumstances, according to M. Bérigny of Versailles, only one part in ten thousand, yet it must be admitted, that when in any quantity, some portion cannot but be absorbed in the mucous and general surfaces, and be able to affect the system. This is clearly proved, when we consider that a

healthy man in twenty-four hours absorbs no less than 576·000 cubic inches of air; that he breathes twenty times in a minute, and at such times takes into his lungs twenty cubic inches of air. This volume of air, impregnated with any substance, hygienic (ozone) or mephitic (malarious), comes in contact at each respiration with no less than 201·600 square inches of absorbing surface in the air-passages and bronchial cells. If, then, the ozone in the atmosphere is pretty well developed, a quantity could be absorbed sufficient to check or put a stop to a moderate quantity of malaria.

Along the Bights, on the Guinea Coast of Africa, the lagoon is the source of the most deadly emanations; and I may here quote, *verbatim et literatim*, a sanitary report of Quittah station (Bight of Benin) for the two weeks ending the 31st May 1860, which I forwarded to the principal medical officer of the Gold Coast command:—

Sanitary report of Quittah.

"In viewing the sanitarium for the last two weeks of May, I have to report very unfavourably with respect to the amount of disease, when compared with the corresponding weeks in the preceding months. It substantiates the now universally believed fact, that the beginning of the rains is the most unhealthy time in the year, fever being more virulent than at any other period, even more than at the harvest or end of the rains.

"The sanitarium of Quittah station may be examined internally, that is, within the fort, and externally, in the town and neighbouring villages. In the fort much mischief does not exist amongst the men. Besides two cases of fever, there were one of Guinea-worm and one of orcheitis, viz., one in 5·3 ill.

"In the towns and neighbouring villages there had been several cases of fever, some very severe, others mild, both amongst native and foreign inhabitants, either of long or short residence.

"It would appear that vessels in the roads are not exempt from it. Not that the infection travels over the sea, *haud quaquam*, but they obtain the infection by landing, as soon becomes manifest. Facts corroborate this statement, for the

captain of the 'St Hiliers,' a merchant brig from Jersey, was landed a corpse at Quittah, a few days ago. From inquiry I found that four days ago he landed at Lagos, and on his way from that place to Quittah, which occupied only three days under sail, he had the fever, and died just as the vessel arrived in port.

"Meteorological phenomena went decidedly to account for this unhealthiness. On the 11th and 26th there was not the slightest trace of ozone in the atmosphere, whilst in some days only 0°·1, 0°·2, and 0°·4 could be obtained, contrary to the high degrees I had obtained in the preceding months. The maximum degree of thermometer was in the morning, 81°·10; noon, 86°; evening, 83°·45. Minimum—morning, 75°; noon, 80°; evening, 78°. Dew-point.—Maximum—morning, 78°; noon, 78°·50; evening, 78°. Minimum—morning, 71°; noon, 74°; evening, 73°. Hygrometer.—Maximum—morning, 4°; noon, 9°; evening, 9°. Minimum—morning, 1°; noon, 4°; evening, 3°. Saturation of the atmosphere.—Maximum—morning, 978°·0; noon, 877°·0; evening, 906°·0. Minimum—morning, 818°·4; noon, 675°·2; evening, 695°·8.

"What, then, is the *origo mali?* I answer, the lagoon *par excellens.*"

It has sometimes been asserted by foreign inhabitants, residing south of the Volta, that the lagoon does not give out malaria, that, in fact, it is healthy—advancing, as a presumptive reason, that "its water is a salt water, and salt water is opposed to malaria." When we consider the number of cases of paludal fever which occur in the region, and that the only marsh is to be found in the lagoon, one could hardly account for it otherwise. I have always maintained, and I do still positively believe, that the lagoon is the source of this pestiferous poison.

1st, Because it contains a less amount of salt than the water of the sea, the proportion being about one-fourth.

2d, Because at its banks vegetable and animal putrescent

matters are to be found, which, when washed of their salt by the rain, form an abundant source of malaria.

3d, Because its banks, which extend about 250 to 300 feet (breadth), covered with low, rank grass, form generally several beds, which receive the rain-water, and become stagnant pools, which are prolific in the generation of littoral poison.

Paludal or littoral poison is given out in deadly quantity from these sources, drifted by the W., W.S.W., N. and N.E. winds; *cæteris paribus,* it becomes pernicious to individuals residing in those tracts of land lying on the border of the sea.

Ergo, the lagoon is undoubtedly the source of malaria. To prove more substantially that the lagoon is the *fons et origo mali,* on the evening of the 18th May I went down the banks of the lagoon, and walked slowly up and down for twenty minutes, exposing myself in every conceivable way to the effects of malaria. Every circumstance was favourable to its generation. The breeze was blowing from W.S.W., along a tract of the malarious beds for at least twenty miles; the vegetation near where I stood had been removed by farmers, and rank vegetation and pools of stagnant water were almost under my feet. On referring to the meteorological observation which I kept, I found the ozonometer to be as low as 0°·5; during the whole of the day the thermometer was 84°; dew-point, 73°; hygrometer, 9°; saturation of the atmosphere, 695°·8; tension of aqueous vapour, 1°·104. The quantity of ozone, which is nature's grand and stupendous neutraliser of malaria, was remarkably small. This is proved to be a positive fact by comparison with the corresponding day of the two preceding months, which we find to have been in March 6°·4, and in April 4°·1 The other observations on the same evening in April stood as follow—thermometer, 85°; dew-point, 78°; hygrometer, 7°; saturation of the atmosphere, 771°·1; tension of aqueous vapour, 1°·241.

I returned to the fort, and as a precaution, in order that, should I get the fever, it might not be too strong, I took one grain of the disulphate of quinine. I slept very sound that

night; but in the morning I felt a little seedy, though I thought nothing of it. I lost my appetite, and began to feel a degree of lassitude, langour, and weariness, as the day advanced, and I felt that I could not apply my mental powers to anything. I therefore lay down quietly. At two o'clock I felt a burning sensation all over my body, commencing from my feet. I had a severe headache, and, in fact, all the symptoms of remittent fever in the form in which it generally attacks one. The sweating stage came on at half-past seven, and I was then relieved, but still suffered from severe headache. I now used the proper means for preventing its reappearance, which succeeded. The next day I felt much better, but rather weak, and suffered from slight headache, and in three days after the exposure I felt as well as before.

The facts to be gathered from this are, not only that malaria exists in the lagoon, but that it also exists in a very concentrated form; that its influence is speedily manifested in the system, although it is probable that in some individuals it may not show itself for some days.

The lagoon, therefore, or its banks, form several beds from which are generated certain deadly poisons, which, in contact with the human system, produce those phenomena known as fever, *quod erat demonstrandum.*

Lesions in the sympathetic system the cause of malarious fever.

Whilst considering the subject of ozone in reference to fever, I cannot pass over the very important view of Mr Richard Hughes as to the periodicity of ague, and the *rationale* and *modus operandi* in the treatment with quinine and arsenic. Hitherto we have been perfectly ignorant of the action of quinine in rapidly checking the debilitating and deteriorating effects of ague, but the views now entertained seem to throw some light on the subject.

He argued, from the coincidental effects produced by the cold stage of ague, viz., the chill, desertion of the blood from the superficial capillaries, and the consequent paleness, dry and rough skin, and sunken features, quick and anxious respiration, feeble pulse, and diminished secretion; and that pro-

duced by the galvanization of the sympathetic nerves in the neck, as exemplified by the experiments of M. Broun-Sequard, viz., dilatation of the pupils, desertion of the blood from the superficial vessels, diminution or absolute check of the secretions, and the lowering of the temperature and all vital functions,*—that *the cold* stage of ague may be produced artificially by the excitation of the sympathetic nerves upon which depend the contraction of the blood-vessel. The *hot stage* is produced by a natural reaction of the blood-vessels to even beyond their natural calibre, which phenomenon is observed also in the division of the sympathetic nerve.

From noticing these circumstances, he came to the conclusion that the sympathetic system was the part of the organism specially affected by malarious poison, and that the phenomena of ague depend on a periodical excitement of it by the poison, "followed by an unequally immoderate reaction in the opposite direction, which latter at length settled down the equilibrium of health."

As I have served for some time in the hot-beds of malaria, where aguish and other paludal fevers were of daily occurrence, and where the atmosphere teems with pestiferous ghastly miasmatic exhalations, especially at some seasons, from the combined sources of the ever-swampy banks of the lagoon, lake pools of stagnant fresh water, and ochletic poison from the effete matter of both man and beast, made indiscriminately in the streets and lanes of large and populous towns, I think I may be allowed to offer an opinion on the subject.

The view as to the sympathetic system being the organism attacked by malarious or paludal poison, will enable us to explain many of the concomitant symptoms of intermittent and other fevers; and although pathological lesions have not as yet been found in that system enough to enlighten us as to its true nature and condition, yet still we are enabled, by the various changes in the viscera, in the neighbourhood of, and abundantly supplied by, the sympathetic system, to believe

* Lecture ix. in *Lancet*, vol. i. 1858.

that there must be some changes in the sympathetic ganglia which lead to those morbid changes in these visceræ.

One great and troublesome symptom is the severe vomiting or nausea which invariably accompanies ague in Africa. As the sympathetic system governs the functional action of the stomach and bowels, then, as a necessary sequence, its derangement produces a derangement also in the healthy actions of that organ. There is generally, in these cases, an aversion to food, but very great thirst. The vomiting in many cases is exceedingly alarming, and prostrates the patient, especially if he has been addicted to a too liberal use of alcoholic liquors. It may be assumed, that the deranged sympathetic nerve which supplies the stomach leads to the secretion of substances from the blood which produce a constant irritation, and which cannot be sustained, and therefore must be evacuated. The secretion of only a small quantity keeps up a constant state of nausea without any evacuation, and the cessation bespeaks the restored healthy action of the nerve.

Effects of ague on the spleen, liver, and lymphatics.—The spleen, I need not add, is supplied with a lash of nerves from the splenic plexus of the semilunar ganglion. By repeated occurrence of ague, as in several cases I have seen on the coast of Africa, the spleen becomes very much hypertrophied. It becomes reduced in size by the use of quinine and iron and the iodine paint, but another attack of ague, or even undue exposure to the malarious poison, although without the manifestation of the fever, is sufficient to produce re-enlargement.

This enlargement has hitherto been considered as produced by the poison in the blood, but several considerations have led me to doubt the truth of the assertion. When we consider the effect that will be produced by undue excitement or irritation of the lash of nerves with which it is supplied, the increased activity which is given to the vessels distributed in it, and the enormous engorgement which will follow as a consequence, the undue enlargement is at once explained. This enlargement, in the first case, if the nervous excitement is not much pro-

longed, gradually disappears without the use of any medicament; but when it assumes a chronic character, its reduction becomes exceedingly slow; it seems as if it would become permanent, and therefore requires the use of powerful drugs to reduce it. In children the reduction takes place quicker than in adults ; for in many cases under my care, no sooner was the quinine, iron, and iodine paint employed, than the enlargement began rapidly to reduce.

The effects on the liver are not so well marked as in the spleen, as the enlargement, although definite, is still slow, except when accelerated by the too immoderate use of spirituous liquor.

The lymphatics of the intestines being supplied by the sympathetic nerves, share the same fate, but the swelling is generally moderate.

Headache.—In some individuals I have seen ague begin with severe headache, after an exposure in malarious districts. The headache is generally very intense, with burning sensations all over the body. This, in most cases, is accompanied with a feeling of nausea, and assumes the character of nervous headache, which pain, according to Dr Symonds, is located in the vaso-motor of the sympathetic nerves of the brain and skull. In almost every case of ague the patient suffers more or less from headache.

The periodic fits.—From arguments drawn from the rhythmical action of the heart, and the periodical monthly phenomenon of menstruation in the female uterus, both of which organs are principally supplied with, and exclusively animated by the sympathetic ganglia distributed in them, Mr Hughes draws the conclusion, that the periodical character of ague is dependent upon a periodicity impressed upon the sympathetic system, and manifested in all the phenomena, morbid and natural, over which it presides.

Assuming this data to be correct, the action of quinine and arsenic, and also of ozone, can be easily explained by admitting that they produce a powerful effect upon the sympathetic

system. The two former medicines are introduced through the proper channel, viz., the stomach, and the last, ozone, through the lungs, and by an immediate effect on the sympathetic nerves distributed over the general sentient surface. This powerful effect is remarkably observed in the case of a flash of forked lightning, which leads to the formation of extraordinary quantities of ozone in the atmosphere.

The observations above detailed respecting the powerful check ozone has over malarious fevers, its existence putting a *veto* on the effects of malarious poisons, go far to substantiate this opinion; although it might as well be stated here, that in some extraordinary seasons, from purely epidemic influences, fever breaks out amongst the inhabitants, ozone being moderately plentiful in the air; but in these cases the fever is easily subdued.

A few months ago Dr Bence Jones and M. Dupré, whilst experimenting on the bodies of guinea pigs, found a substance closely resembling the alkaloid of cinchona, which they call Anima quinoidine, and which they regard as the earliest products of the downward passage of albumen. Dr Bence Jones believes that quinine acts by supplying artificially a natural constituent of the animal economy which has been destroyed by the poison of marshy swamps or other causes. Quinine a constituent of the body.

The experiments were made with a view to ascertain the rate at which substances passed into and out of the textures. "They chose quinine because of its effects, or rather the effect of an acid solution of it, upon light. Quinine was given to one guinea pig and withheld from another. Both were killed. The organs and tissues of each were subjected to a process of heating in a water-bath with very dilute sulphuric acid, and from the tissues of the one that had not taken quinine was extracted a fluorescent substance, the solution of which acted on the spectrum almost precisely as the solution of quinine. Not only by the mode of its extraction from the tissues and its behaviour towards light was this substance not to be distinguished from quinine, but in its chemical actions with various

other substances."* When this shall have been confirmed by further similar experiments, and by experiments also on the bodies of men and animals residing in malarious districts, we may then possibly arrive at a most satisfactory explanation of the action of quinine.

Ozone a natural constituent of the body.

It has also been lately attempted to prove that ozone is a natural constituent of, or present, in the human blood. Herr Kühne made some experiments to prove its existence, but he did not obtain it in the gaseous form. He considers, however, "that when blood saturated with carbonic oxide is perfectly free from oxygen and incapable of absorbing oxygen, it nevertheless possesses the power of converting the oxygen with which it comes in contact into ozone." The action of blood corpuscles he considers to be like finely divided platinum; they ozonise the oxygen, without undergoing any change themselves.

Ozone as a disinfectant.

Dr John Day of Victoria has been experimenting with ozone as a means of purifying the air. He obtained ozone in a very simple way, viz., by moistening the interior of a bell glass receiver, or a large mouthed glass with ether, and plunging into it a glass rod previously heated in a flame of a spirit lamp. The reaction produced was truly characteristic of ozone. It quickly destroyed sulphuretted hydrogen, converted sulphite of lead into sulphate, liberated iodine from iodide of potassium, rapidly decolorised a solution of sulphate of indigo, thus proving that it possesses powerful bleaching properties, oxidised iron and silver when slightly moistened, coagulated albumen and casein, altering their colour, and giving them a greenish tinge, and inhaled for some time it produced intense headache and sore throat.

Ozone thus made keeps for a long time within the bottle, and can be taken out by rubbing any substance, a towel, for instance, in the interior of the bottle; the towel becomes ozonised, and remains so for some time. "Viewing ozone as oxygen in a dynamical condition," says Dr Day, "its increased activity

* *Lancet*, p. 492, May 5, 1866.

giving it the power of rapidly converting the products of animal and vegetable decomposition into innocuous compounds, I began to test the power of this chemical ozone in a privy, the atmosphere of which was highly charged with sulphuretted hydrogen, and probably other deleterious gases. Before commencing operations, I placed a vessel containing a weak solution of permanganate of potash on the seat, the lead being raised. In an hour the colour was perfectly destroyed. I then placed large glass jars, which had been ozonised by means of ether, and a hot glass rod in several parts of the privy; and by this, and other methods about to be described, I have kept the air so pure, that a solution of permanganate of potash, of the same strength as that first used, will retain its colour for several days." By the means here adopted, sheets, blankets, beds, clothing, bandages, lint, and many other substances, might be ozonised and used as powerful disinfectants.

Ozone is generated by the vapour of the oil of turpentine, oil of cajeput, carbolic, and pyroligneous acid, creosote, naphtha, coal-tar, and even chloroform. Might it not be of great service when epidemic visitation takes place, that ozone should be used for purifying the air of chambers, &c.?—or be continually used in places where malaria is continually generated?

CHAPTER XIV.

1. DISEASES OF THE RAINY SEASON CONTINUED.—2. METEORIC CAUSES OF YELLOW FEVER IN BATHURST, RIVER GAMBIA, IN 1866.—3. GOVERNOR D'ARCY'S ORDINANCE REGULATING SANITARY COMMISSION ESTABLISHED IN THE GAMBIA.—4. DISEASES OF THE HARMATTAN OR COLD SEASON.—5. MORTALITY AND REGISTRATION OF BLACK TROOPS AND INHABITANTS IN WESTERN AFRICA.

Yellow fever of 1866.

EVERY inhabitant of the River Gambia will long remember the epidemic outbreak of yellow fever during the year 1859, and no one will forget the ravages which a pestilential endemic outbreak committed amongst the few European inhabitants of Bathurst in 1866. The demon of the marsh had an unfettered scope over the whole population, white and black—the former suffering from yellow fever of the most malignant form, and the latter from bilious remittent fever, and dysentery and diarrhœa. The cry ran through every lip that the destroying angel was hovering over the small swampy island of St Mary's, and "who will be spared to see the end of the season?"

St Mary's, as we have seen, is surrounded on the west, south-west, and south, by the most pestilential mangrove swamp, over which, during the blowing of the south-west monsoon, the wind must pass, and waft its deadly emanations into the town of Bathurst. When the rainy season commences with much lightning and thunder and plenty of rain, this poisonous exhalation is greatly neutralised, although not entirely destroyed, and the season is considered healthy, because the

type of fever is generally mild, being mostly of the intermittent variety. When there is little thunder and lightning, and a plentiful quantity of rain, the type of fever is more severe, being of the remittent variety, accompanied with severe congestion; but when the demon of the marsh is allowed to exercise its deadly influence unrestrained by any such phenomena, there being no thunder or lightning, and but very little rain, fever of the most malignant type becomes prevalent, such as yellow fever and ardent congestive fever.

The commencement of the rainy season of 1866 in the River Gambia was marked with unusual calm, the thermometrical observations during the months of May and June, instead of being higher than those of July and August, were comparatively lower. The fall of the thermometer in May, after the hot days in April, was not gradually maintained, but the thermometer again rose in July and August, when it should have been further lowered. Meteoric observations.

The maximum daily thermometrical observation for the month of May was 99°, and this was the height about the latter part of the month, and during eight days. In June it was 99° for nine days, especially during the latter part. In July it was 99° for no less than twenty days out of the thirty, and for August 99° during fourteen days of the month, proving that the maximum thermometer of July and August was not lower than that of May and June, but that there were, in fact, more hot days in the first two than in the last two months.

The minimum daily thermometrical register was in May 60° during ten days; in June, 60° during fifteen days; in July, 60° during twenty-three days; and in August, 60° during twenty-two days.

The mean observations prove also that the months of July and August, instead of being colder, were hotter than the months of May and June. The maximum mean daily thermometer in May was 80°·9 during two days of the month; on the 29th it was 79°·4; in June it was 84°·2 during one day; on the 20th it was 82°·8; 21st, it was 82°·4; 3d, it was 82°·2. In

July it was 85° during one day; on the 15th it was 83°·9; 11th, was 83°·8; 14th, was 83°·6. In August it was 85°·1 during one day; on 2d, it was 84°; 4th, it was 83°·1.

The minimum mean daily thermometer in May was 70°·1 and 70°·6 during two days; in June, 75°·0 and 75°·8 during two days; in July, 78°·0, 78°·1, 78°·6 during three days; in August, 70°·1, 72°·3 during two days.

The maximum daily range shows that the highest range was more persistent in July and August than in May and June, when the contrary should have been the case. The maximum daily range of the thermometer in May was 39° during only one day; for three days it was 38°; in June it was 39° for four days, and during four days it was 38°; but in July it was 39° during fourteen days, and 38° during seven days; in August it was 39° for ten days, and during eight days it was 38°.

In examining the minimum daily range, we find that the months of July and August show the highest range. In May it was 21° during one day in the month, and the next lowest register was 23°. In June it was 23° during one day, the next lowest being 27°; but in July it was 29° during one day, the next lowest was 33°; and in August it was 27° during two days, and the next lowest was 29°.

The pluviametrical observations prove also that the rain-fall was extremely small; in fact, we might justly state, in a comparative point of view, that there had scarcely been any rain during the months of May, June, July, and August, the quantity being only sufficient to allow animal and vegetable putrefaction to take place undisturbed. In May there were only two days of rain-fall, and the quantity in inches was 10·4. In June it was still less; a slight drizzle on the 23rd, the quantity ·01 inches. In July the quantity was 6·72 for thirteen days of rain, and in August the quantity was 19·84 for twenty days of rain. In the preceding chapter (X., page 187) I have shown that at Sierra Leone the total quantity of rain-fall in 1829, for the month of June, was 64·55

inches; for July, 125·55 inches; and for August, 123·80. Still later, in 1858, the total quantity for May was 8·95 inches, which is more than the quantity of rain-fall in July 1866 at the Gambia by 2·23 inches; in June it was 12·27 inches; and in July, 23·50. In 1860, the quantity in May was 10·24 inches; June, 15·3 inches; and August, 26·86 inches.

It will be seen at once from the above, that the quantity of rain-fall in the River Gambia for 1866 had been remarkably small, after making all allowances for its position within the zone of the trade-winds, the whole quantity for the four months of May, June, July, and August, being only 27·71 inches; that is, 0·85 inches of rain-fall more than what took place at Sierra Leone for the month of August in 1860.

Again, on the breaking out of the monsoon, in the month of May and in June, there are always thunder and lightning, fierce and vivid, which purify the atmosphere from the deadly emanations which are produced by the occasional rain and the accompanying heat. In 1866, however, there was no tornado or lightning, and thunderstorms were not heard. It was a calm, quiet season, and the old inhabitants prognosticated that, should the weather continue, there would be a great deal of sickness. The practical governor, with his clerk of works, Mr J. B. Campbell, went about the town ordering the inhabitants to clean their streets, to drain all stagnant pools, to root out rank vegetation, and to observe bodily cleanliness, as they anticipated cholera or other malignant fever.

The wind was at this time blowing from south-west and north-west, over an extensive unhealthy mangrove swamp seven miles in length, scarcely less dangerous than the classic Pontine marsh; the rank vegetation was just growing; the ebb tide left amongst it and the aerial roots of the mangroves, deposits from the sea and river; the burning heat, with the little rain, favoured exhalations from the alluvial soil of which Bathurst is composed, as well as the deadly effects of Half Die, which during the waumie is half under water. All these neutralised the efforts of Governor D'Arcy and his

clerk of works, and yellow fever of the most fatal type broke out amongst the inhabitants.

Air of the Cape and Bathurst compared.

Being stationed, at its first outbreak, in the sanitarium at Cape St Mary's, I was enabled to compare the effects of the south-west breeze in the two places when I was ordered in. At the Cape the air was moist, exhilarating, and pure, containing a large quantity of ozone, which it derives from the surface of the sea. As one enters into Bathurst, only a distance of seven and a-half miles, the air is oppressive, and has the properties of a "tainted vapour-bath." It produces a feeling of langour and oppression, of general lassitude and weakness, with a profuse and exhausting perspiration; vital activity seems to be much weakened and diminished; all energy forsakes the body, and man seems to vegetate rather than live. This was my feeling when I first rode up from Cape St Mary's to Bathurst, when the yellow fever was making a terrible havoc amongst the few European inhabitants in the colony.

The first case of yellow fever was in a large French house. The clerk, who was very temperate, as most Frenchmen are in tropical climates, was attacked under circumstances of rather a peculiar nature. He was up in the morning in perfect health, and was engaged weighing some cow-hides. There was among them one hide which had not been properly dried, and had become putrefied, and the smell from it made him vomit a great deal. Even the native labourers who were employed were sick from it. The clerk took to his bed, black vomit came on, and he died from a decided and rapid case of yellow fever. This took place about the end of June. In July and beginning of August, as we have seen, the thermometer continued persistently high, and there was only a small rain-fall. The fever spread through the town with increased violence, and one, and another, and another, fell victims to its deadly grasp. The agent and another clerk died in that French house, and the rest ran away to a more healthy clime. Amongst the victims of the yellow fever were two medical officers, viz., Dr Hammond, staff assistant surgeon, who had only a few days

before arrived from England, and Dr Calvert, staff surgeon and principal medical officer, who was much respected and deeply mourned by the inhabitants, and who having taken an active part in the epidemic visitation of yellow fever in the Gambia in 1859, had volunteered to come from his station at M'Carthy's Island to Bathurst.

From the foregoing it will be perceived that the yellow fever in Bathurst, River Gambia, in the year 1866, was purely endemic, that it had its origin from local and atmospheric causes, and that it was confined only to a very limited area. When the yellow fever was raging, Governor D'Arcy, with the aid of his councillors, passed a most important ordinance, which might really serve as a guide to all the Coast Governments. He formed a Sanitary Commission, consisting of five or six members, whose duty it was to attend to the cleanliness and other matters relative to the health of the town. I shall here give the ordinance in full, trusting that when such a fearful visitation takes place, as is almost always the case at the beginning of the rains at Freetown and Sierra Leone, similar measures will be adopted for saving the lives of Her Majesty's subjects :—

"At a Council holden on the 18th day of August, one thousand eight hundred and sixty-six.

"An ordinance to make provision for the sanitary regulation of the settlements on the River Gambia.

"Whereas these settlements are occasionally visited by yellow fever, and other epidemical diseases, which are believed to be in a great measure the result of neglect of sanitary precautions, and whereas it is necessary to make provision to meet the evil: Be it enacted— Preamble.

"1. That from and after the publication of this ordinance, the officer administering the government of these settlements for the time being, shall from time to time, and when he may see fit, appoint sanitary commissioners, and by proclamation invest them with the full powers provided in this ordinance. Power to appoint sanitary commissioners.

"2. That the sanitary commissioners when appointed shall, and are hereby empowered to visit all parts of any settlement Commissioners to visit all places, and enter any premises.

for which they may be appointed, and it shall be lawful for them to enter any buildings, yards, or premises they may see fit, for the purpose of ascertaining their sanitary condition.

Power to remove vessels and all other articles from the beach, wharf, &c.

"That the sanitary commissioners shall, and are hereby empowered to cause all vessels, boats, canoes, wood, dirt, rags, broken bottles or glass, and any article or thing whatsoever which they may consider necessary, to be removed from any wharf, beach, road, street, or drain, within the settlement for which they may be appointed.

Owners of lots to keep the streets and roads clean.

"That every person owning or dwelling in any lot or parcel of land shall be bound and be responsible to keep the street, road, and drain in front of his or her said lot clean and in proper order, but where lots face each other the respective owners shall be responsible as aforesaid for keeping only one half the street, road, and drain clean and in proper order. And any filth, rags, or dirt which may be found opposite any lot shall be removed by the person or persons responsible as aforesaid, at their own cost, to such place as the sanitary commissioners may appoint. And any person refusing or neglecting to comply with this regulation shall, on conviction before any justice of the peace, forfeit the sum of £2 for the first offence, or be imprisoned and put to hard labour for one month, and for any subsequent offence shall forfeit, on conviction, the sum of £5, or be imprisoned as aforesaid for the space of two months.

Penalty for refusal.

Vessels, &c., to be removed at cost of owners.

"The owner of any vessel, boat, canoe, bricks, or any article whatever which the sanitary commissioners may find on any wharf, beach, street, road, or premises, and which they may consider should be removed, shall remove the same at their own cost, or place them in such position as the said sanitary commissioners may order and direct. And any person refusing or neglecting to comply with such order or direction of the said commissioners shall, upon conviction before any justice of the peace, forfeit any sum not less than £5, nor exceeding £20, or be imprisoned, with or without hard labour, for any time not exceeding three months.

Penalty for refusal.

"That any order or direction of the sanitary commissioners respecting any cesspool, privy, or drain on any premises, shall be strictly complied with by the owner or occupier of the same, and any person refusing or neglecting to comply with such order or direction shall, on conviction as aforesaid, suffer the penalties hereinbefore provided for persons neglecting or refusing to keep the streets, roads, and drains clean.

Orders respecting cesspools and drains to be observed.

Penalty for refusal.

"That the sanitary commissioners, if they see fit, shall cause any goods, merchandise, produce, or hides, which they may be medically advised are injurious to health, to be removed from any building or premises to such place as they may appoint; and any person owning or occupying such building or premises who shall neglect or refuse to remove such goods, merchandise, produce, or hides as aforesaid, shall, on conviction before any justice of the peace, forfeit the sum of £10 for the first offence, and £20 for the second offence, and, in default of payment, shall be imprisoned, with or without hard labour, for any period not exceeding three months.

Powers respecting goods, produce, and hides.

Penalty for refusal.

"That when the occasion for which the sanitary commissioners have been appointed shall cease, the officer administering the government shall, by proclamation, announce the same, upon which the appointment of the commissioners shall then cease, together with the powers herein given to them.

Powers of commissioners to cease by proclamation.

"That during such time as there may be no epidemic, or no commissioners appointed, the health officer shall have full power, as given to the sanitary commissioners, to cause all streets, roads, and drains to be kept clean and in proper order by the owners and occupiers of lots; and any person neglecting or refusing to keep the said streets, roads, and drains clean and in proper order, shall, on conviction as aforesaid, suffer the penalties provided for not keeping the same clean and in order.

Health officer's powers to keep streets, &c., clean at all times.

"That the health officer shall also cause all filth, broken bottles, rags, and dirt to be removed from the beach or any

Health officer to keep beach, &c., clean.

wharf by such persons as may be given to assist him by the officer administering the government.

Health officer to cause removal of rotting and decaying vessels, wood, or any article.

"That the health officer shall cause the owner of any vessel, boat, canoe, wood, or any article which shall be rotting and decaying on or in any part of the beach, wharf, street, or road, to remove the same; and should any person neglect or refuse to comply, such person shall, on conviction before any justice of the peace, forfeit the sum of £5, or be imprisoned, with or without hard labour, for the space of one month.

Proceedings when owners are not known.

"Should the sanitary commissioners or the health officer be unable to find any owner to any vessel, boat, canoe, wood, or other article which should be removed, they shall affix a notice on or near the vessel, boat, canoe, wood, or other article, that the same is to be removed; and if no steps shall be taken within three days to remove the same, they shall cause it to be removed at the expense of the colony; and should any owner afterwards be found, he shall, on conviction before any justice, be liable to refund the expense incurred, in addition to any other punishment to which he may be sentenced. Should the vessel, boat, canoe, wood, or other article, be rotting and decaying, the sanitary commissioners or the health officer shall, if no owner can be found, cause the same to be burned or destroyed.

Cesspools to be purified once in each month at certain periods.

"That the owner or occupier of any lot wherein there is a privy or cesspool, shall, once in each month, between the 1st day of June and the 30th of November in each year, cause at least one bushel of lime or powdered charcoal to be thrown into the same; and should any person, on information given, be convicted before any justice of the peace of neglecting to comply with this provision, such person shall be fined in the sum of 10s., or be imprisoned for the space of one month. One-half of the said fine shall be paid to the informer.

Penalty for neglect.

Commissioners' orders signed by one of them, or the secretary, to be binding.

"That any order signed by a sanitary commissioner, or by the secretary to the commissioners, shall be sufficient and binding on all parties under this ordinance."

This able ordinance was drawn up by Assistant Commissary Blanc (since deceased).

About the beginning of September there was an entire change in the meteoric state of the country. The thermometer, which had been constantly high, began steadily to reduce. For the first few days of the month the quantity of rain-fall was plentiful and constant. During the outbreak there was a constant grayish or bluish-gray haze over the town of Bathurst, commencing from Half Die to the burial ground, which was seen from the Cape, and which was not dispersed by the breeze. This heavy cloud was no longer visible, but only a mist, easily dispersed as soon as the sun was up. The wind was still blowing from the malarious swamp, but the atmosphere seemed more bracing and less depressing. For nine successive months, *i.e.*, since December, there had scarcely been any thunder or lightning. In the thunder months of May, June, and July, there was none heard, nor was there any lightning; but now the reserved electricity seemed, as it were, to explode with immense rapidity and force. Every evening and night the lightning, in splendid forms of zig-zag, sheet, and forked, flashed from skies to skies, and then darted on the negatively-electrified ground, accompanied with tremendous roars and explosions of the vast atmospheric Leyden jar. On the night of the 12th instant, at 12 o'clock, there was such a severe thunder-storm, without rain or tornado, that it woke nearly all the inhabitants from their deepest sleep. The heavens seemed to quake in such a way as had not been heard for years. The morbific influence of the marsh was incapable of withstanding the produce of so powerful an agent. The grayish-blue mist, which had for nearly six weeks hung over the town of Bathurst, was dispersed. All the yellow fever cases began rapidly to decline; no new case, even amongst new arrivals, was registered; the Europeans, instead of having the yellow jack, now got mild remittent fever; and the natives, who were laid up in scores with severe bilious remittent, now got the mild intermittent. The number of European inhabitants at the time of the outbreak was thirty, and fifteen fell victims to its deadly grasp.

Meteoric causes of the cessation of yellow fever.

Cessation of the yellow fever.

The endemic outbreak of yellow fever, therefore, we might fairly state, died away, principally from the *materies morba* being destroyed by the products of lightning and thunder-storms, and the draining and flooding effect of heavy rain.

In the epidemic of yellow fever in Sierra Leone in 1858 and 1859, there was not one case in the barracks, which, as we have before described, is situated on a great elevation in the centre of the town. This proves how powerfully hygienic is elevation in preventing the spread of malarious disease, and should lead to the occupation of the high lands behind the city.

Yellow fever and sea voyage.

It was the practice during that epidemic to send men who were suffering from yellow fever on a sea voyage by the contract mail steamer; the result proved this practice to be very injurious. In a commencing case, the sea air, with the inconvenience of "on board the ship" under a tropical heat, seems to accelerate the effects of the poison by acting on the liver. From all the accounts I could gather from the captains, there was not a case of recovery amongst those who embarked whilst suffering from the fever. They generally died before or about the fourth or fifth day. Most of them suffered from severe delirium. Of three cases that died on board the "Ethiope" in one of her voyages, two were delirious for a couple of days before death, and one for twenty-four hours. The black vomit commenced as soon as they were conveyed on board. Towards the ebb of life their lips, teeth, and tongue became blackish-blue, and in severe cases there was bleeding from the gums.

In some of the cases on board the contract steamers the nervous system was hyperæsthetically affected, the lips and muscles quivered convulsively, speaking produced great excitement and exhaustion, the thirst was craving, with ability to drink any quantity of water, but no desire for food, and not much purging. In one case, twelve hours before death, the patient ate an enormous quantity of food. Not one of those who had gone on board after the yellow fever had been contracted, escaped; one died six hours after leaving port. It is,

therefore, against every precedent to advise a person labouring under yellow fever in Western Africa to travel by sea; they have better chance of recovery on land; but as soon as they become convalescent, and are able to move about, a sea voyage produces in them a most beneficial result. Exactly the contrary is the case with intermittent and remittent fevers, which begin to decline as soon as the patient enters the vessel.

During this season of the year Guinea-worm is more prevalent on the Gold Coast than at any other time; the cold season seems to be its period of irritation, although it may occur at any other period. This may be explained from the supposition, that during the hot season the temperature of the body is uniform, especially in the exposed lower extremities of the poor, which is the general abode of the worm; but during the rains, the worm, occurring amongst those who go barefooted and expose their feet to wet and cold, and consequent changes in the temperature, feels the change, and if loaded with ova, endeavours to make its escape; it then causes severe inflammation and a blister over the part where it intends to make its exit, and then protrudes through it. Guinea-worm in the rains.

Elephantiasis Arabum, also, is very troublesome at this season, and generally commences at this time, especially when it is caused by Guinea-worm. The leg begins gradually to enlarge, with very little or no pain at all, and increases without stopping, through all the seasons, when once it has commenced. This disease is noticed in Dix Cove, Gold Coast. Elephantiasis.

Goitre, or swelling of the thyroid gland, commences also at this season of the year in countries where it is endemic. It is greatly favoured by the cold, and commences with a soft, very yielding tumour. In one case that I saw, the whole of the neck was swollen, deglutition was impeded, and much pain and inflammation accompanied it. In the majority of cases it begins very insidiously, and the glands swell gradually without attracting the notice of the patient; then, from being soft and yielding, it becomes hard. There is no hereditary ten- Goitre.

dency in most of the cases, and it occurs amongst the strong and robust. This disease is noticed in the swampy island of M'Carthy's, several miles inland of the River Gambia; the soil appears to contain a large quantity of lime.

Diseases of the Harmattan or Cold Season.

Effects of the harmattan in small-pox.

This season has been justly considered the most healthy on the coast; fever is of very rare occurrence. The harmattan cold, dry wind of the desert places a veto on animal and vegetable decomposition, and, consequently, on malarious exhalations, and, consequently, malarious fever is uncommon in this season. Those suffering in convalescence are restored to their proper health; all malignant diseases, as if by magic, disappear; ulcers quickly cicatrise, and cutaneous eruptions are arrested. Even the most dreadful outbreak of small-pox cannot withstand it; the pustules soon heal up, and the disease disappears. If the best vaccine matter be used for inoculation whilst the harmattan wind is blowing, its effect is nullified, and the system becomes perfectly exposed, as an unvaccinated patient, to the baneful influence of the epidemic. It has exactly the same effect with the exanthematous fevers, curing them by hastening the different stages, or without allowing them to run their regular course. In the year 1770 there were on board the "Unity," at Whydah, about 300 slaves. The small-pox broke out among them, and it was determined to inoculate. Those who were inoculated before the harmattan came on got very well through the disease. About seventy were inoculated a day or two after the harmattan set in, but not one of them had either sickness or eruption. It was imagined that the infection was effectually dispersed, and the ship cleared of the disorder; but in a very few weeks it began to appear among those seventy. About fifty of them were inoculated a second time; the others had the disease in the natural way. A harmattan came on, and they all recovered, except one girl, who had an ugly ulcer in the

inoculated part, and died some time afterwards of a locked jaw.*

Effects of the harmattan on the sentient surface.

In the interior of the Gambia and Senegal, the harmattan blows more regularly for days, and even weeks continually, than at any other part of the coast. The air is dry, and produces a sensation of a sharp cold, which is pleasant. This cold is superficial, and an individual generally feels an increased degree of activity; "the skin reddens, and, in extreme cases, the limbs have a tendency to stiffen, instead of yielding to the irregular and involuntary motions which constitute shivering." An unpleasant dryness is felt in the mucous coat of the nostrils as the wind passes along it; the hair bristles fearfully; the lips chap and split; the kidneys are called upon to do more work; there is very little, if any, perspiration, even after a long walk; the sudorific glands are in a quiescent state, as well as the sebaceous follicles, which is remarked by the dry, harsh feel of the surface, now deprived of its unctuous secretion. Those who have resided in the tropics become goose skinned and shrivelled, their hands becoming uncomfortably dry.

Fever in harmattan season.

In the intermediate days between the harmattan the weather is generally hot, sometimes windy, but deprived of the unpleasant dry sensation. Individuals are generally subject to fevers, which might have been prevented by the preceding harmattan days. The fever is, however, peculiar, and characterised by a feeling of general lassitude, uneasiness, slight headache, burning in the nostrils, a burning heat in some individuals, a coldish sensation all over the body, a pretty good appetite, but no decided prostration or fever, and in a few days, with some individuals, without even taking any medicine, the fever subsides of itself.

Sometimes when the harmattan blows for several days, and the kidneys do not act sufficiently, the bowels act vicariously, and relieve the system of the superabundant accumulation, and diarrhœa sets in and continues in spite of all remedies.

* Philosophical Transactions, vol. lxxi.

It causes very little pain, and sometimes none at all, and is characterised by copious watery discharges, coloured by loose fæcal matter. As soon as the cold wind subsides, and the skin resumes its action, the diarrhœa also gradually subsides, and the patient returns to his usual health.

Diseases of harmattan season. The diseases of this season consist of disease of the internal organs. The blood recedes from the surface, and accumulates in the interior; indurated, sub-acute inflammation of the liver and spleen are common; hæmorrhages sometimes take place; there may only be slight derangement of the hepatic functions, consisting of "irregularity of the bowels, with motions of various colours, and fœtid or insipid odour; general languor of body and mind; slight nausea, especially in the mornings, when we attempt to brush our teeth; a yellowish fur about the back part of the tongue; unpleasant taste in the mouth on getting out of bed; a tinge in the eyes and complexion from absorption of bile; the urine high coloured, and a slight irritation in passing it; the appetite impaired, and easily turned against fat or oily victuals; irritability of temper, dejection of mind, loss of flesh, disturbed sleep." But sometimes this increases greatly, and the patient becomes affected with jaundice, with or without any pain in the region of the liver. Chronic eruptions are repelled, and sometimes are followed by headache.

As in India, so in some parts of Africa. "In the old residents," says Sir R. Martin, "the appetite fails, accompanied by an oppressive sense of abdominal fulness; and when this state is not met by a suitable change of diet, clothing, and some medicine to act upon the skin and bowels, visceral congestion, œdema of the lower extremities, or some more active disease, may ensue. New-born infants suffer materially from, and are sometimes destroyed by, the impression of our cold season on the unguarded and delicate surface. The abortions of the cold months have always appeared to me connected with acute nervous congestion; and the intermittent states of the pulse and the epigastric pulsations, common to old Indians at this season, are increased by this state of the great nervous

trunks. The kidneys act during the continuance of the cold weather with diabetic violence, the urine being limpid, and they only cease to do so on the return of a warmer season, and consequently equability of circulation, causing moisture of surface. The biliary excretion, in excess during hot and rainy seasons, is here diminished, as indicated by the whitish or clay-coloured state of the alvine discharges, following the reverse order of what takes place in the instance of the kidneys." The functions of the liver in a great many cases are depraved.

On the West Coast of Africa individuals of arthritic temperament suffer most severely from gout and rheumatism at certain seasons of the year, occasioned either by excessive debauchery, undue exposure, or hereditary predisposition; and in a great many cases we can only account for the cessation from meteoric circumstances. I have seen patients suffering most severely from the worst forms of gout and rheumatism, with flying pains all over the body, swollen joints, intense local pains, with a deposit of what is wrongly called chalk-stone, before the occurrence of the harmattan wind; and when it blows, all, like a spell, disappear; the swelling is greatly reduced, there is no pain, and the patient is able to move about with ease and comfort, and generally expresses himself to be "*jolly;*" but no sooner does the harmattan cease, and the N., S., or N.W. winds begin to blow, than the symptoms gradually begin to reappear, much to his discomfort. The best remedy used by the natives in the Bight of Benin for gout and rheumatism is the fat of the boa-constrictor. I have never had an opportunity of examining its effects; but judging from the statements of the natives, it seems to possess a powerful penetrative action. It is employed also in consumptive pains in the chest, which, they say, it greatly relieves. Rheumatism.

During the harmattan season pregnant females suffer a good deal from cold and coughs, which they describe as far exceeding any other time; and they also observe that the cold is less felt when in an unpregnated state, although the weather is of the same temperature. They, however, feel lighter and more Impregnation.

able to move about than previously, if they have suffered from great weight and heaviness. Labour during this season is very quick. It takes about three-fourths of the ordinary time. The patients generally complain of severe cold and trembling just before and after the commencement of labour pains. The pains then come on, and the uterus seems to act with double energy and force. The pains are principally dragging lumbar pains. After delivery, severe pains are felt all over the lumbar and pelvic regions, and in the hip joints; but they continue only for a short time, and then disappear. This wind has an invigorative effect on the galactophorous glands. A dry, scanty breast now secretes a large and abundant quantity of milk.

Effects on infants.

The young infant at this season of the year suffers much from cold, especially amongst the lower class. The babe is said to cry much more than at any other time, and is much more troublesome in nursing. Glandular swellings are common amongst them, especially those three or four years of age, which generally run on to the formation of matter. The principal glands affected are the parotid, submaxillary, and glandular concatinatæ. Sometimes the swellings are so large that they extend the cervical fascia to such a degree as to impede the healthy action of the large vessels, and interrupt breathing. A most extreme case of the kind came under my notice on the Slave Coast in the month of January 1860. The patient was a girl of five years of age, and during the occurrence of a severe harmattan in the beginning of the month had suffered from the glands of the neck. When I saw her the parotid, submaxillary, thyroid, and all the other glands of the neck had become involved. The cervical fascia was considerably stretched; she suffered from severe pain, and was quite unable to turn her head one way or the other. The breathing was very stertorous and hurried, ranging from 50 to 56. She had a slight cough, and her deglutition was much impeded. The child, which was said to have been strong and stout, was now reduced to a skeleton; the eyes, standing out of their orbits, staring ghastly; cheek sunken, and the bones of the face prominent; the great

cervical vessels and air-passages were so compressed that their proper functions were entirely interrupted, and that, with the inability to take food and the dyspepsia, led to ill nourishment of the system and deprivation of the blood. The child was, in fact, dying from inanition. A lancet discharged a large quantity of matter; the pain diminished; the number of respirations fell; the breathing became more natural; a revival was observed in the countenance; and the child, who was at death's door, now looks lively, and enjoys its meals.

How far the statement of Dr Lind,* that the harmattan is a "*malignant and fatal wind*," is true, I leave my readers to form their own opinion.

Mortality and Registration of the Black Troops and Inhabitants in Western Africa.

Dr T. Graham Balfour, F.R.S., Deputy Inspector-General of Hospitals, in his able summary of the health of the army all over the world, published in the "Statistical Reports of the Army Medical Department" for 1859 to 1862, gives the following as the rate of sickness and mortality of British troops on the West Coast of Africa:— Mortality of black troops.

West African Stations.

1. In *Sierra Leone* the sickness is represented by 740 admissions, and the mortality by 29·53 deaths *per* 1000 of mean strength.

2. At the *Gambia* the sickness is represented by 978 admissions, and the mortality by 33·74 deaths *per* 1000 of mean strength.

3. On the *Gold Coast* the sickness is represented by 624 admissions, and the mortality by 26·45 deaths *per* 1000 of mean strength.

The *Gambia* and *Sierra Leone* seem to be the most sickly; but the average duration of the cases of sickness, and the

* Diseases of Hot Climates.

mortality compared with the admissions, is greatest on the *Gold Coast.*

The most prevalent miasmatic diseases in *Sierra Leone* are as follow :—

Paroxysmal fevers, represented by 98 admissions *per* 1000 mean strength ; *rheumatism,* by 56 *per* 1000 ; *dysentery* and *diarrhœa,* by 20 ; *eruptive fevers,* by 23 *per* 1000.

The most prevalent on the *Gambia* are :—

Paroxysmal fevers, represented by 294 admissions *per* 1000 of mean strength ; *dysentery, diarrhœa,* and *cholera,* by 58 *per* 1000 ; *eruptive fevers,* by 44 *per* 1000 ; *rheumatism,* by 28 *per* 1000 ; *ophthalmia,* by 13 admissions *per* 1000 men.

The most prevalent on the Gold Coast are :—

Dysentery, diarrhœa, and *cholera,* represented by 31 admissions *per* 1000 mean strength ; *rheumatism,* by 26 *per* 1000 ; *ophthalmia,* by 19 *per* 1000 ; *paroxysmal fever,* by 11 admissions *per* 1000. *Smallpox* and *measles* are sometimes epidemic, and Guinea-worm among parasitic diseases holds a prominent place. Indeed, in 1861, this affection was the cause of one-third of the admissions into hospital ; and it is worthy of remark, that in that year not a single case occurred among the troops at Sierra Leone and the Gambia.

The two following tables will show the greatest number of annual admissions and mortality in the stations on the West Coast of Africa :—

I.

Stations of British Army on West Coast of Africa, arranged in order of the greatest Number of Annual Admissions per 1000 of Mean Strength.	Annual Admissions per 1000 Mean Strength.	Annual Mortality per 1000 Mean Strength.
Gambia, ...	978	33·74
Sierra Leone, ...	740	29·43
Gold Coast, ...	624	26·45

II.

Stations of British Army on West Coast of Africa, arranged in order of the greatest Number of Annual Mortality per 1000 of Mean Strength.	Annual Mortality per 1000 Mean Strength.	Annual Admissions per 1000 Mean Strength.
Gambia, ...	33·74	978
Sierra Leone, ...	29·53	740
Gold Coast, ...	26·45	624

MORTALITY OF THE BLACK TROOPS SERVING ON THE WEST COAST OF AFRICA AND IN THE WEST INDIES, TAKEN FROM THE REPORTS OF THE ARMY MEDICAL DEPARTMENT PRESENTED TO PARLIAMENT.*

West Coast of Africa.

PLACE.	Ratio of Deaths per 1000 Men.		
	1859 & 1860.	1861.	1862.
Sierra Leone, ...	24·48	40·53	28·36
Gambia, ...	30·13	46·40	19·13
Gold Coast, ...	16·89	42·64	28·74
Lagos, ...	...	...	28·57

West Indies.

PLACE.	Ratio of Deaths per 1000 Men.		
	1859 & 1860.	1861.	1862.
Windward and Leeward Command, ...	21·86	20·85	18·92
Jamaica, ...	31·20	18·65	30·25
Bahamas, ...	30·45	26·33	27·31
Honduras, ...	20·57	16·12	16·30

* Report of Select Committee on Africa (Western Coast), 1865.

TABLE SHOWING THE PROPORTION OF ADMISSIONS INTO HOSPITAL AND DEATHS, PER 1000 MEAN STRENGTH, ON THE AVERAGE OF THE PERIODS NOTED.

Stations and Period of Observations.	Sierra Leone, 1859-1862.		Gambia, 1859-1862.		Gold Coast, 1859-1862.	
Diseases.	Admissions.	Deaths.	Admissions.	Deaths.	Admissions.	Deaths.
Miasmatic Diseases, .	227	4·92	458	4·60	103	4·96
Enthetic Diseases, . .	142	...	153	1·53	41	...
Dietetic Diseases, . .	1	·70	3	...	2	...
Parasitic Diseases, . .	19	...	14	...	223	...
Diathetic Diseases, . .	4	...	9	2·30	1	...
Tubercular Diseases, .	16	7·74	14	9·20	5	3·31
Diseases of the—						
Nervous System, .	14	4·22	15	1·53	12	3·31
Circulatory System,	1	...	2	1·53	...	·83
Respiratory System,	67	4·92	94	8·43	29	4·13
Digestive System, .	26	4·22	28	·77	24	2·47
Reproductive System,	5	...	3	...	6	...
Urinary System, .	1	...	4	·77	3	...
Locomotive System,	13	·70	8	·77	12	...
Integumentary System,	124	...	96	...	99	...
Diseases of Nutrition, .	1	...	1	...	...	...
Accidents, ...	56	...	57	...	56	4·96
Battle, ...	15	2·11	8	...	...	...
Homicide, ...	...	...	1	·77	...	...
Suicide, ...	...	...	...	·77	...	·83
Execution, ...	...	...	...	·77	...	1·65
Corporal Punishment,	6	...	5	...	6	...
Not Specified, . . .	2	...	5	...	2	...
Total, . . .	740	29·53	978	33·74	624	26·45

Registration in Western Africa.

On the West Coast of Africa the Registrarship of Births, Deaths, and Marriages is not vested in the medical profession, and, consequently, it will be impossible to get accurate returns of the causes of death. How will these Registrars appear if, in the Central Government, a Medical Registrar-General was appointed, and the following instructions, which were sent by the Registrar-General of all England to his two thousand two hundred reporting officers, were sent to them?—

"If the deaths registered during the quarter have been above or below the average, state whether, in your opinion, the fact is wholly or partially to be accounted for by sanitary arrangements, by increase or decrease of population, the weather,

small-pox, measles, scarlatina, whooping-cough, fever (including typhus, typhoid, relapsing, infantile fever), cholera, diarrhœa (including bowel complaint), dysentery, bronchitis, or other diseases. Also with regard to increase or decrease of births, you may mention any circumstance to which it may be attributed. By 'average' must be understood, not the average of numbers in other quarters of the year, but the average of *corresponding* quarters in four or five previous years."

This proves at once that we shall ever be ignorant of the proper death rate until the plan is remodelled. And now that the whole coast is placed under a Central Government, the Governor-General should appoint medical registrars in the different colonies, should have a Medical Registrar-General in Sierra Leone, and should have quarterly or half yearly reports sent as to the rate of mortality, which should be summarised by the Registrar-General, and published for public information in the Government *Gazette*. There will still be some fallacy in the report, which will be unsatisfactory until the people be compelled to get a medical certificate for each death. I hope this suggestion will meet with the approbation and consideration of the Central Government.

YEARLY RETURN OF CASES OF DISEASES TREATED IN THE COLONIAL HOSPITAL AT KISSY.—DR DEANE, ASST.-COL. SURGEON.

I.—FROM 1ST APRIL 1845 TO 31ST MARCH 1846.

(*From the Sierra Leone Almanac for* 1854.

DISEASE.	Remained on the 31st Mar. 1845.	Admitted.	Total.	Recovered.	Died.	Absconded.	Remaining on the 31st Mar. 1846.
Dropsy, ...	10	123	133	46	83	...	4
Diarrhœa, . . .	12	105	117	73	43	...	1
Epilepsy, . . .	3	5	8	2	5	...	1
Frambœsia, . .	4	32	36	23	...	...	13
Herpes, ...	1	1	2	2	...	...	...
Lepra, ...	6	22	28	10	7	...	11
Lethargus, . . .	5	27	32	2	29	...	1
Nausea, ...	26	26	52	11	19	...	22
Noli me tangere, .	8	8	16	10	...	...	6
Rheumatism, . .	5	18	23	21	1	...	1
Syphilis, . . .	4	11	15	9	5	...	1
Scrofula, . . .	4	20	24	14	3	...	7
Ulcers, ...	35	170	223	183	21	...	19
Kra Kra, . . .	6	92	98	97	...	...	1
Dysentery, . . .	50	652	702	172	527	...	3
Catarrhus Chr. .	2	73	75	53	22	...	...
Variola, ...	38	...	38	35	3	...	...
Pleuritis, . . .	3	39	42	22	21	...	...
Debility, . . .	5	47	52	21	28	...	3
Caries, ...	1	...	1	...	...	...	1
Intermittent Fever,	3	14	17	16	1	...	...
Gonorrhœa, . .	1	1	2	2	...	...	...
Varicella, . . .	10	23	33	32	1	...	...
Ophthalmia, . .	...	20	20	20	...	...	...
Lacerated Wound,	...	1	1	1	...	...	...
Remittent Fever,	...	19	19	5	14	...	...
Enlarged Scrotum,	...	1	1	1	...	...	...
Dyspepsia, . . .	...	1	1	1	...	...	...
Dracunculus, . .	...	2	2	1	...	...	1
Icterus, ...	...	2	2	1	1	...	...
Impotence, . . .	...	1	1	1	...	...	...
Paralysis, . . .	...	3	3	...	2	...	1
Pertussis, . . .	...	1	1	...	1	...	...
Phthisis, . . .	...	2	2	...	2	...	...
Fracture, . . .	...	1	1	...	...	...	1
Rubeola, . . .	...	3	3	3	...	...	...
Enlarged Nymphæ,	...	1	1	1	...	...	...
Wound, ...	...	2	2	...	...	...	2
Total, . .	260	1569	1829	890	839	...	100

II.—FROM 1ST APRIL 1846 TO 31ST MARCH 1847.

DISEASE.	Remained on the 31st Mar. 1846.	Admitted.	Total.	Recovered.	Died.	Absconded.	Remaining on the 31st Mar. 1847.
Dropsy, ...	4	19	23	10	12	...	1
Diarrhœa, . . .	1	33	34	32	1	...	1
Epilepsy, . . .	1	4	5	...	4	...	1
Frambœsia, . .	13	19	32	19	...	...	13
Lepra, ...	11	15	26	8	3	...	15
Lethargus, . . .	1	24	25	3	17	...	5
Mania, ...	22	34	56	19	15	...	22
Noli me tangere, .	6	6	12	5	2	...	5
Rheumatism, . .	1	20	21	19	2	...	...
Syphilis, . . .	1	9	10	7	2	...	1
Scrofula, ...	7	15	22	16	2	...	4
Ulcers, ...	19	59	78	54	7	...	17
Kra Kra, . . .	1	2	3	3	...	...	...
Dysentery, . . .	3	39	42	25	14	...	3
Debility, ...	3	31	34	17	14	...	3
Caries, ...	1	...	1	...	..	...	1
Dracunculus, . .	1	...	1	1	...	...	...
Paralysis, .	1	6	7	2	3	..	2
Fracture, . . .	1	1	2	2	...	...	...
Wound, ...	2	4	6	6	...	...	...
Gonorrhœa, . . .	...	4	4	4	...	...	...
Pleuritis, . . .	...	17	17	8	4	...	5
Abscess, ...	...	8	8	8	...	...	...
Rubeola, ...	...	2	2	2	...	...	...
Catarrhus Chr. .	...	8	8	5	...	...	3
Caligo, ...	...	1	1	1	...	...	...
Hernia Humoralis,	...	1	1	1	...	...	...
Hernia, Scrotal, .	...	1	1	1	...	...	...
Icterus, ...	...	2	2	2	...	...	...
Enlarged Scrotum,	...	2	2	2	...	...	...
Ophthalmia, . .	..	4	4	1	...	...	3
Phthisis, . . .	...	3	3	...	3	..	...
Rickets, ...	...	1	1	...	...	...	1
Phrenitis, . . .	...	1	1	...	1	...	...
Tetanus, ...	...	1	1	..	1	...	...
Tabes Mesenterica,	...	1	1	...	...	...	1
Erysipelas, . . .	...	1	1	1	...	...	..
Tænia, ...	...	1	1	...	...	...	1
Bubo, ...	...	1	1	1	...	...	...
Remittent Fever, .	...	3	3	2	1	...	...
Stricture, . . .	...	1	1	...	...	...	1
Pleurodynia, . .	...	1	1	1	...	...	...
Cataract, . . .	...	1	1	...	...	...	...
Fistula, ...	...	1	1	1	...	...	1
Contusion, . . .	...	1	1	...	1	...	
Psoriasis, . . .	..	1	1	...	1	...	
Intermittent Fever,	...	5	5	5	...	..	...
Total, . . .	100	414	514	294	110	...	110

III.—From 1st April 1847 to 31st March 1848.

DISEASE.	Remained on the 31st Mar. 1847.	Admitted.	Total.	Recovered.	Died.	Absconded.	Remaining on the 31st Mar. 1848.
Mania, . . .	22	21	43	9	13	...	21
Frambœsia, . .	13	52	65	44	...	...	21
Lepra, ...	15	21	36	14	13	...	9
Noli me tangere,	5	4	9	5	1	...	3
Syphilis, . . .	1	11	12	7	3	...	2
Scrofula, . . .	4	16	20	11	7	...	7
Ulcers, . . .	17	150	167	118	30	...	19
Caries, . . .	1	1	2	1	...	...	1
Lethargus, . .	5	22	27	1	24	...	2
Paralysis, . .	2	16	18	3	12	...	3
Debility, . . .	3	208	211	84	116	...	11
Epilepsy, . . .	1	5	6	3	3	...	...
Ophthalmia, . .	3	26	29	28	...	...	1
Dysentery, . .	3	1134	1137	234	840	...	63
Dropsy, . . .	1	332	333	80	230	...	23
Pleuritis, . .	5	66	71	22	47	...	2
Diarrhœa, . .	1	189	190	108	81	...	5
Catarrhus Chr.,	3	187	190	68	110	...	12
Rickets, . . .	1	...	1	...	...	...	1
Tabes Mesenterica,	1	...	1	..	...	...	1
Tænia, . . .	1	...	1	1	....	...	...
Stricture, . .	1	2	3	2	1	...	...
Cataract, . . .	1	1	2	2	...	...	...
Bubo, ...	...	1	1	1	...	...	...
Wound, . . .	...	5	5	5	...	...	...
Intermittent Fever	...	7	7	7	...	..	...
Dry Bellyache, .	...	2	2	1	1	...	...
Remittent Fever,	...	23	23	12	10	...	1
Kra Kra, . . .	...	86	86	82	1	...	3
Phthisis, . .	...	7	7	...	5	...	2
Abscess, . . .	...	24	24	23	...	...	1
Rheumatism, .	...	59	59	23	29	...	7
Tormina, . . .	...	12	12	12	...	...	...
Hernia Humoralis,	...	2	2	2	...	...	...
Rubeola, . . .	...	122	122	50	71	...	1
Gonorrhœa, . .	...	12	12	6	4	...	2
Lumbricus, . .	...	3	3	2	1	...	...
Dracunculus, .	.	5	5	4	...	...	1
Tetanus, . . .	...	2	2	...	2	...	...
Fracture, . . .	...	2	2	2	...	...	...
Tumour, . . .	...	7	7	7	...	...	...
Varicella, . .	...	86	86	53	31	...	2
Emaciation, . .	...	14	14	3	11	...	...
Caligo, . . .	...	3	3	1	1	...	1
Hernia Scroti, .	...	7	7	3	4	...	...
Elephantiasis, .	...	4	4	1	3	...	...
Pneumonia, . .	...	1	1	...	1	...	...
Amputation, .	...	1	1	1	...	...	...
Icterus, . . .	...	2	2	1	1	...	...
Splenitis, . .	...	3	3	3	...	...	...
Obstipatio, . .	...	3	3	...	3	...	...
Catarrhus Acutus,	...	21	21	9	10	...	2
Cerebritis, . .	...	1	1	1	...	...	...
Vertigo, . . .	...	7	7	1	4	...	2
Dyspepsia, . .	...	5	5	1	3	...	1
Synovitis, . .	...	1	1	...	1	...	...
Aphthæ, . . .	...	2	2	2	...	...	...
Psoriasis, . .	...	1	1	...	1	...	...
Contusion, . .	...	1	1	1	...	...	...
Variola, . . .	...	3	3	3	...	...	...
Constipatio, . .	...	2	2	1	...	...	1
Peritonitis, . .	...	1	1	...	1	...	...
Total, . .	110	3014	3124	1165	1730	...	229

IV.—FROM 1ST APRIL 1849 TO 31ST MARCH 1850.

DISEASE.	Remained on the 31st Mar. 1850.	Admitted.	Total.	Recovered.	Died.	Absconded.	Remaining on the 31st Mar. 1853.
Mania, ...	36	52	88	26	14	...	48
Lepra, ...	3	6	9	4	2	...	3
Debility, . . .	3	62	65	52	10	...	3
Hemiplegia, . .	1	1	2	2	...	...	...
Ulcer, ...	40	124	164	135	11	...	18
Rheumatism, . .	2	25	27	17	4	...	6
Ophthalmia, . .	1	8	9	8	1	..	...
Noli me tangere, .	3	1	4	4	...	...	...
Œdema, ...	2	3	5	4	1	...	...
Diarrhœa, . . .	6	40	46	30	12	...	4
Scrofula, . . .	4	10	14	10	3	.	1
Kra Kra, . . .	1	26	27	23	3	...	1
Catarrhus Chr., .	2	34	36	22	11	...	3
Frambœsia, . .	1	7	8	7	..	...	1
Dysentery, . . .	3	35	38	11	25	..	2
Abscess, ...	2	15	17	15	1	...	1
Aphthæ, ...	1	1	2	2	...	...	...
Paralysis, . . .	2	3	5	4	...	...	1
Ascites, ...	2	10	12	6	5	..	1
Dracunculus, . .	1	2	3	3	...	...	.
Syphilis, . . .	4	5	9	7	1	...	1
Lethargus, . . .	5	23	28	5	21	...	2
Dementia, . . .	3	3	6	4	2	...	...
Epilepsy, . . .	2	2	4	...	4	..	..
Variola, ...	1	57	58	48	7	...	3
Lupus, ...	2	23	25	22	...	...	3
Fistula, ...	1	...	1	1	...	...	...
Varicella, . . .	1	1	2	2	...	...	.
Elephantiasis, . .	...	1	1	...	...	...	1
Intermittent Fever,	...	5	5	5	...	...	...
Gunshot Wound, .	...	1	1	...	1	...	...
Tetanus, ...	...	1	1	...	1	...	...
Rubeola, ...	...	2	2	1	1	...	...
Constipatio, . .	..	11	11	9	2	...	...
Amaurosis, . . .	...	3	3	3	...	...	...
Hepatitis, . . .	...	1	1	...	1	..	...
Tormina, . . .	...	23	23	21	...	...	2
Incised Wound, .	...	3	3	2	1	...	...
Blind, ...	...	3	3	2	...	...	1
Anasarca, . . .	...	3	3	2	...	...	1
Sprain, ...	...	2	2	2	...	...	...
Bruise, ...	...	1	1	1	...	..	...
Remittent Fever, .	...	3	3	2	...	...	1
Fracture, . . .	...	5	5	4	1	...	...
Phthisis, . . .	...	5	5	...	5	...	..
Vertigo, . . .	...	5	5	3	...	...	2
Contused Wound,	...	1	1	...	...	...	1
Laryngitis, . . .	...	1	1	1	...	...	...
Burn, ...	...	1	1	1	...	..	...
Total, . . .	135	660	795	533	151	...	111

These tables only show the number of cases of diseases amongst the liberated Africans who were taken from the slave-ships and forwarded to the Kissy Hospital. The slaves are generally in a wretched state of health when landed, and subject to every kind of disease. The tables there do not show the number of admissions and the mortality amongst the population at Kissy, but only the number amongst the emancipated slaves.

The following tables of the mortality of the River Gambia from 1859 to 1866 were kindly furnished me by Mr Thomas Johnson, the registrar of births, marriages, and deaths, expressly for this work. In 1859 and 1866 the colony was visited with yellow fever, and consequently the mortality amongst the small European population was very large.

MORTALITY AMONGST THE NATIVE AND EUROPEAN POPULATION AT BATHURST, RIVER GAMBIA, FOR THE YEARS 1859, 1860, 1861, 1862, 1863, 1864, 1865, AND 1866.

Mortality for 1859.

MONTHS.	Number of Deaths amongst the Black and Coloured Population.								Number of Deaths amongst White Population (all Ages).
	Male Population—Ages.				Female Population—Ages.				
	1 to 7	7 to 20	20 to 40	40 and upwards.	1 to 7	7 to 20	20 to 40	40 and upwards.	
January, .	9	0	7	0	1	1	2	3	0
February,.	4	3	3	2	0	0	2	0	0
March, .	6	2	3	2	3	1	1	1	0
April, . .	0	1	2	2	4	1	2	0	0
May, . .	0	1	6	1	3	1	6	1	0
June, . .	2	0	1	2	2	1	1	0	0
July, . .	2	0	5	2	2	3	5	1	2
August, .	4	2	1	2	2	0	1	2	9
September,	4	2	3	1	4	0	2	1	3
October, .	3	0	1	3	4	1	1	1	0
November,	9	0	3	1	2	0	0	2	0
December,	4	2	2	1	4	2	1	1	0
Total, .	47	13	37	19	31	11	24	13	14

Mortality for 1860.

MONTHS.	Number of Deaths amongst the Black and Coloured Population.								Number of Deaths amongst White Population (all Ages).
	Male Population—Ages.				Female Population—Ages.				
	1 to 7	7 to 20	20 to 40	40 and Upwards	1 to 7	7 to 20	20 to 40	40 and upwards.	
January, .	3	3	1	1	3	2	2	0	0
February,	2	2	2	0	3	3	1	1	0
March, .	3	2	4	2	2	1	0	0	2
April, .	1	0	1	0	1	0	0	1	0
May, . .	3	3	1	3	0	3	1	1	0
June, . .	2	1	5	2	0	0	4	1	0
July, . .	3	2	0	6	3	0	1	1	2
August, .	4	0	3	0	4	2	0	3	0
September,	2	0	5	3	3	1	0	6	0
October, .	3	0	4	2	2	2	1	1	1
November,	4	2	3	1	2	1	0	2	0
December,	4	0	7	2	6	1	1	2	0
Total, .	34	15	36	22	29	16	11	19	5

Mortality for 1861.

MONTHS.	Number of Deaths amongst the Black and Coloured Population.								Number of Deaths amongst White Population (all Ages)
	Male Population—Ages.				Female Population—Ages.				
	1 to 7	7 to 20	20 to 40	40 and upwards.	1 to 7	7 to 20	20 to 40	40 and upwards.	
January, .	1	3	4	4	3	1	0	2	0
February,	5	1	2	1	4	1	0	1	0
March, .	2	0	8	3	3	0	2	3	0
April, . .	2	3	4	3	3	0	1	1	1
May, . .	3	0	1	0	1	0	2	2	1
June, . .	2	0	2	3	4	1	1	0	0
July, . .	1	2	3	1	6	0	3	0	0
August, .	2	0	4	0	2	1	1	0	0
September,	3	3	1	1	3	2	4	0	1
October, .	3	0	1	1	4	0	2	0	0
November,	3	0	7	2	0	1	0	1	1
December,	7	4	3	2	4	2	1	1	2
Total, .	34	16	40	21	37	9	17	11	6

Mortality for 1862.

MONTHS.	Number of Deaths amongst the Black and Coloured Population.								Number of Deaths amongst White Population (all Ages).
	Male Population—Ages.				Female Population—Ages.				
	1 to 7	7 to 20	20 to 40	40 and upwards.	1 to 7	7 to 20	20 to 40	40 and upwards.	
January, .	5	2	0	0	2	0	4	0	1
February, .	1	0	2	0	3	2	1	3	0
March, .	0	0	0	0	2	1	0	0	0
April, . .	1	1	3	2	5	2	0	0	0
May, . .	4	2	3	0	0	0	0	0	0
June, . .	3	0	1	1	4	2	2	1	0
July, . .	1	0	5	0	0	0	2	1	2
August, .	5	0	5	2	5	1	1	0	0
September,	7	2	2	4	3	1	2	0	0
October, .	7	2	1	2	0	1	1	2	0
November,	3	0	5	3	0	0	2	1	1
December,	2	2	28	0	3	7	0	1	0
Total, .	39	11	55	14	27	17	15	9	4

Mortality for 1863.

MONTHS.	Number of Deaths amongst the Black and Coloured Population.								Number of Deaths a mongst White Population (all Ages).
	Male Population—Ages.				Female Population—Ages.				
	1 to 7	7 to 20	20 to 40	40 and upwards.	1 to 7	7 to 20	20 to 40	40 and upwards.	
January, .	0	0	7	2	2	0	5	2	0
February, .	3	1	4	4	2	3	1	1	1
March, .	3	2	4	2	6	0	1	2	2
April, . .	4	3	0	2	2	4	2	6	0
May, . .	6	2	7	1	1	2	2	3	1
June, . .	5	1	4	6	8	1	1	4	1
July, . .	14	4	1	6	9	0	1	1	0
August, .	8	1	3	1	9	1	5	2	1
September,	12	3	2	3	12	0	2	1	2
October, .	9	4	3	1	9	1	2	5	0
November,	1	3	3	2	2	2	1	5	0
December,	3	1	6	4	3	0	8	3	0
Total, .	68	25	44	34	65	14	31	35	8

Mortality for 1864.

MONTHS.	Number of Deaths amongst the Black and Coloured Population.								Number of Deaths amongst White Population (all Ages).
	Male Population—Ages.				Female Population—Ages.				
	1 to 7	7 to 20	20 to 40	40 and upwards.	1 to 7	7 to 20	20 to 40	40 and upwards.	
January, .	0	1	6	5	2	1	2	1	0
February,	2	1	4	4	0	4	0	2	0
March, .	3	2	3	2	3	0	0	1	0
April, . .	2	1	1	2	0	0	4	0	0
May, . .	4	1	2	1	0	0	0	1	0
June, . .	4	0	5	3	2	0	2	2	0
July, . .	7	1	3	1	3	2	1	1	0
August, .	5	3	11	3	8	1	7	3	1
September,	10	2	8	2	10	0	4	2	0
October, .	7	2	3	1	6	3	4	1	1
November,	4	1	5	1	4	0	6	1	0
December,	3	1	5	1	2	0	1	2	0
Total, .	51	16	56	26	40	11	31	17	2

Mortality for 1865.

MONTHS.	Number of Deaths amongst the Black and Coloured Population.								Number of Deaths amongst White Population (all Ages).
	Male Population—Ages.				Female Population—Ages.				
	1 to 7	7 to 20	20 to 40	40 and upwards.	1 to 7	7 to 20	20 to 40	40 and upwards.	
January, .	4	1	3	4	0	1	3	3	0
February,	3	0	2	0	3	1	3	0	0
March, .	4	0	3	1	2	0	0	1	0
April, . .	1	0	4	1	1	1	1	1	0
May, . .	2	1	5	1	0	0	2	3	0
June, . .	2	2	3	1	2	1	0	0	0
July, . .	5	1	1	0	5	0	3	1	1
August, .	5	0	3	1	5	2	3	0	0
September,	5	1	1	1	2	0	3	0	3
October, .	6	1	4	1	6	3	3	1	1
November,	5	0	3	0	3	2	2	1	0
December,	2	1	2	2	1	0	1	3	0
Total, .	44	8	34	13	30	11	24	14	5

Mortality for 1866.—*From January to the* 12*th of October.*

MONTHS.	Number of Deaths amongst the Black and Coloured Population.								Number of Deaths amongst White Population (all Ages).
	Male Population—Ages.				Female Population—Ages.				
	1 to 7	7 to 20	20 to 40	40 and upwards.	1 to 7	7 to 20	20 to 40	40 and upwards.	
January, .	0	1	2	2	2	1	3	3	0
February, .	1	2	3	2	1	1	3	0	0
March, .	1	1	5	3	0	1	0	1	0
April, . .	3	0	0	2	1	0	2	1	0
May, . .	3	0	3	4	4	1	1	5	0
June, . .	5	1	5	2	1	0	1	1	0
July, . .	2	1	0	2	2	0	1	3	1
August, .	14	2	4	2	10	2	1	1	10
September,	10	0	6	2	8	0	0	0	7
October (to 12th)	2	1	5	1	4	1	0	2	2
November,	0	0	0	0	0	0	0	0	0
December,	0	0	0	0	0	0	0	0	0
Total, .	41	9	33	22	33	7	12	17	20

TOTAL MORTALITY (MALE AND FEMALE) OF BLACK AND COLOURED POPULATION IN THE GAMBIA.

Average Population, 6000.

YEARS.	1 to 7	7 to 20	20 to 40	40 and upwards.	Total Yearly Deaths.
1859,	78	24	61	32	195
1860,	63	31	47	41	182
1861,	71	25	57	32	185
1862,	66	28	70	23	187
1863,	133	39	75	69	316
1864,	91	27	87	43	248
1865,	74	19	58	27	178
1866,	74	16	45	39	174
Total,	650	209	500	306	1665

From the above table it is evident that the highest rate of mortality was between the years of 1 and 7; that should the infant escape this unfortunate period, he stands a chance of

lingering on to manhood, and before he arrives at 40 his existence is terminated; next to childhood, the greatest mortality is from 20 to 40.

MORTALITY OF THE EUROPEAN POPULATION.

Average Population, 35.

1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.
14	5	6	4	8	2	5	20

DIFFERENCE BETWEEN MORTALITY OF MALE AND FEMALE POPULATION IN RIVER GAMBIA.

YEARS.	AGES.							
	1 to 7		7 to 20		20 to 40		40 and upwards.	
	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.
1859,	16	0	2	0	13	...	6	0
1860,	5	0	0	1	25	...	3	0
1861,	0	3	7	0	23	...	10	0
1862,	12	0	0	6	40	...	5	0
1863,	3	0	11	0	13	...	0	1
1864,	11	0	5	0	25	...	9	0
1865,	14	0	0	3	10	...	0	1
1866,	8	0	2	0	21	...	5	0
Total,	69	3	28	10	170	...	38	2

From this table it will be seen that the proportion of male deaths above female is very great, and this takes place after manhood has been attained, between 20 and 40. The total number of deaths at this period, between the years 1859 and 1866 (up to the 12th October), was 500, of which 170 were in excess of male to female population. In childhood, *i.e.*, between 1 and 7, the male infants seem more predisposed to disease than the female, and the excess of mortality during the same period is 66.

The total number of deaths amongst the black and coloured

population in Bathurst, between the years 1859 and 1866 (12th October), of a population of nearly 6000 inhabitants, was 1665, of which 977 were males, and 688 females; the lowest mortality was in 1865, viz., 178; the highest in 1863, when there was famine in the land, the total being 316. The death rate of the male population is much in excess of that of the female; of the 1665 deaths there were no less than 289 male deaths over the female. The smallest difference of mortality between the male and female was in 1865, when there were 20 male excess; the greatest difference was in 1862, when there were 51. For every death of 2·8 females 3 males died; the average yearly excess of male deaths from 1859 to 1866 was 36·1.

TABLE SHOWING TOTAL DEATH RATES OF BOTH SEXES FROM 1859–66.

YEARS.	Male Deaths.	Female Deaths.	Yearly Excess of Male over Female Deaths.
1859, . .	116	79	37
1860, . .	107	75	32
1861, . .	111	74	37
1862, . .	119	68	51
1863, . .	171	145	26
1864, . .	149	99	50
1865, . .	99	79	20
1866 (to 12th October), .	105	69	36
Total, . .	977	688	289

The number of births bear no proportion whatever to that of deaths; there is a slight increase in the number of male over female births. From 1859 to 1866 (30th September) the total number of male births was 432, and that of female births 380; the grand total of all the births registered being 812. The yearly births were as follows:—

YEARS.	Male.	Female.	Total.
1859, . .	58	53	111
1860, . .	65	63	128
1861, . .	47	41	88
1862, . .	64	67	131
1863, . .	46	45	91
1864, . .	53	25	78
1865, . .	51	42	93
1866 (to 30th September,)	48	44	92
Total, . .	432	380	812

The following shows the difference between the births and deaths :—

YEARS.	Total Deaths.	Total Births.	Excess of Deaths over Births.
1859, . .	195	111	84
1860, . .	182	128	54
1861, . .	185	88	97
1862, . .	187	131	56
1863, . .	316	91	225
1864, . .	248	78	170
1865, . .	178	93	85
1866 (to 30th September),	158	92	66
Total, . .	1649	812	837

The total deaths here exceed the total births by 837 ; or the total mortality of the male inhabitants alone, from 1859 to September 30, 1866, exceeded the total male and female births during the same period by 156. The inhabitants occupying the unhealthy town of Bathurst are fast dying out ; there is little or no immigration into it. The population is barely 6000, and at this rate of mortality, with so small a yearly register of births, within fifty years from the present there will

scarcely be found, living in that area a single individual now among its inhabitants, nor even their offspring yet unborn. *They will all die out.* Do the local authorities require any more forcible argument for the necessity of rigid sanitary reforms? Within eight years the deaths exceeded the births by 837. The inhabitants might truly say, "*We do not live; we die.*"

HINTS FOR THE PRESERVATION OF HEALTH BY EUROPEANS IN TROPICAL CLIMATES.

CHAPTER XV.

1. GENERAL OBSERVATIONS ON TROPICAL HYGIENE.—2. RULES FOR THE REGULATION OF THE DRESS, DIET, DRINK, EXERCISE, SLEEP, BATHING, AND THE PASSIONS.—3. PREVENTION OF SOME TROPICAL DISEASES.

General observations

False infatuation.

In every part of the globe, an individual attempting to reside in a climate which is opposite to or varies from that to which he has been accustomed, must conform to certain rules and regimen, regulating his habits to that of the climate he intends to reside in, and if he expects to keep his health, must endeavour to profit by the experience of those who have resided for some time in it. Europeans fresh from Europe are very generally found to praise the climate in the tropics as the best in the world; especially if they have been in the south of Europe, you will hear them say that it is quite as good, if not better; and they will unnecessarily expose themselves to a great many injurious climatic influences, and pooh-pooh any advice to the contrary offered them by persons whose long residence and experience in such matters should carry with it great weight. Such individuals have generally within a few weeks or months to pay most dearly for their folly, and should they be lucky enough to outlive their opinions, soon tell a

different tale. I knew an eminent judge who had resided for some time in the south of Spain. On his arrival on the Gold Coast, finding that the south-west sea breeze was very bracing, and the air tolerable but bearably hot, he walked about from one part of the town to the other under the noon-day sun. He could not endure the slow pace of a carriage, which in that part of Africa is drawn by men ; and on one occasion he jumped out and raced with the native drivers. What was the result? He soon took fever, congestion of the brain followed, and he became a victim of the climate,—or rather of his infatuation, within six weeks after his arrival.

How true, then, are the remarks of Captain Williamson (who resided for some twenty years in India), when writing of the folly of some new arrivals, who unnecessarily exposed themselves to the injurious influence of the climate. "Nothing," said he, "can be more preposterous than the significant sneers of gentlemen on their first arrival in India—meaning thereby to ridicule or to despise what they consider effeminacy or luxury. Thus several may be seen walking about without chattahs* during the greatest heats. They affect to be ashamed of requiring aid, and endeavour to uphold, by such a display of indifference, the great reliance placed on strength of constitution. This unhappy infatuation rarely exceeds a few days; at the end of that time, we are too often called upon to attend the funeral of the self-deluded victim." One cannot be too cautious, especially on his first arrival in tropical climates; he has so to moderate all his habits of life—his drink, sleep, exercise, &c.—as gradually to adapt his constitution to the necessitudes of the climate. A mistake at the commencement may lay the foundation of the most serious and complicated diseases in future years. What madness will it be considered if a native of a tropical climate, in residing in the temperate zone, carries there with him his tropical habits! A few days alone will suffice to bring him to the consciousness of his folly, and reduce him to the dust from whence he came. What is

* Umbrellas.

injurious in the one case is also injurious in the other. A native of a temperate climate, on making the tropics his abode, should gradually adapt himself to the climate, and should particularly observe the minute points in tropical hygiene.

Besides, the death of every new comer tells very much against the climate of the country. The individuals themselves are seldom blamed for it; the deadly nature of the place receives all the blame which their bereaved friends can give, and the progress of the governing influence is checked. The country becomes the sufferer in another way. It is deprived of the civilising influence which radiates from them. It prevents others from attempting to reside in it, and generally only the most reckless and desperate will venture to do so.

The subject of tropical hygiene has been ably considered by many writers on tropical diseases; and in the following considerations I intend to adopt the plan proposed by Dr Johnson, and most elaborately improved by Sir R. Martin, and regard tropical hygiene in the light of Dress, Food, Drink, Exercise, Sleep, Bathing, and the Regulation of the Passions.

Before considering these various points, I shall here quote the summary of the precautions sent by the French Minister of War to the troops in the East (Danube), to be observed for the preservation of their health, as I think valuable hints might be obtained from it for the guidance of habits in the tropics:*—

Instructions of French Council of Health.

"The Council of Health has been charged by the Minister of War to examine the precautions most proper for maintaining the health of the troops in the country to which they are called to make war. The Council has drawn up detailed instructions, from which the following particulars are extracted as necessary to be observed with the greatest care:—

"1. It is necessary to be always so clothed as to be proof against the sudden chills to which one is liable, at all seasons,

* Published in "British and Foreign Medico-Chirurgical Review," p. 424, April 1855.

from the abrupt changes of temperature which very frequently happen in nearly all parts of this country.

"2. In summer the best protection against sunstrokes, which are often very dangerous, is never to leave shelter without having the head covered.

"3. Cleanliness of person, clothes, and dwellings is imperiously required by the nature of the climate.

"4. Wherever practicable, the face, and particularly the eyes, should be frequently washed daily, after exposure to dust.

"5. The feet should not be washed with cold water, especially when heated after a march.

"6. The greatest care is needed for protection against the freshness of the nights, even when the heat is extreme. It is dangerous to remain clad only with the shirt during the night. At the bivouac, and in the tent, the soldiers should be very carefully covered.

"7. When the camp is pitched near a marsh, a tank, pools of stagnant water, or a valley, the chief openings of the barracks or tents should be in the opposite direction. In these bivouacs every possible means should be employed to counteract the invariably noxious vapours exhaled by such foci of infection. At night the openings of the barracks, with the exception of those indispensable for ventilation, should be closed.

"8. It is wrong to sleep in immediate contact with the ground; perfectly dry substances, not easily permeated by moisture, should be interposed. For this purpose fresh branches or vegetable matter should never be used.

"9. Water drunk in large quantity is always injurious. If, after a fatiguing march, a stream of water is met with, thirst must be sparingly satisfied, and the water reserved for subsequent use.

"10. When only a small quantity of water is procurable, instead of swallowing it, the mouth should be gargled as long as possible, and the water rejected as soon as it is warm.

"11. When reduced to the necessity of drinking stagnant water, it should, by way of precaution, be strained through a

cloth, to separate leeches, imperceptible from their smallness, and which it is very dangerous to swallow.

"12. A mixture of wine and water, brandy and water, or infusion of coffee and water, is always an excellent drink, taken in moderation. It should be mixed at the time of use, and not prepared beforehand, as it in that case becomes heated, changes, and no longer fulfils its purpose.

"13. When salted meat and fish are substituted for fresh meat, they should be soaked before cooking, and when practicable, mixed with a certain amount of vegetables.

"14. Condiments in small quantity are good seasoning; in excess they irritate the stomach, and render thirst more difficult to bear.

"15. Saffron increases the digestibility of rice and flour. It is particularly useful with maize.

"16. Food should always be taken before a march.

"17. Before and after guard-mounting it is very useful to drink a moderate quantity of warm water, with a little brandy or infusion of coffee in it. Night guards should always be well clothed.

"18. Sickness should at once be reported to the medical officer.

"19. These recommendations shall be published in general orders. Every commanding officer will take care that they are read to the troops once a-week at least, and that the officers superintend and direct their execution."

I.—Dress.

Materials which keep up an equable temperature of the body are the best adapted for the tropics. Linen is very cold, and transmits heat through everything beneath it; and when wet by any source, either by perspiration or rain, communicates a cold sensation over the whole of the body. Woollen fabrics, being bad conductors of heat, feel very uncomfortable, when the temperature of the surrounding medium far exceeds that of

Dress. General observations.

the body; and when it is a little below it, will be found to be too slow a conductor of the heat of the body. Cotton, therefore, is the material best suited for tropical climates. "The cotton dress," says Sir R. Martin, "from its slowness of conducting heat, is admirably adapted for the tropics. It must be recollected that the temperature of the atmosphere, *sub dis*, in the hot seasons, exceeds that of the blood by many degrees; and even in the shade it too often equals, or rises above the heat of the body's *surface*, which is always, during health, some degrees below 97°.

"Here, then, we have a covering which is *cooler* than linen, inasmuch as it conducts more slowly the *excess* of external heat to our bodies; but this, though a great advantage, is not the only one.

"When a *vicissitude* takes place, and the atmospheric temperature sinks suddenly far below that of the body, the cotton covering, faithful to its trust, abstracts more slowly the heat *from it*, and thus preserves to the wearer a more and more steady equilibrium. To all these advantages must be added the facility with which the cotton absorbs perspiration. While linen so circumstanced would feel wet and cold under a breeze, and even occasion a shiver, the cotton dress, as stated, would maintain an equable warmth."

Rules for guidance.

1. A cotton undershirt should always be used; and if drawers be worn, those made with cotton are best.

2. Cotton socks, as a general rule, should be always worn. If about to travel a long distance, and there is a probability of walking through swamp, woollen stockings, not very thick, are preferable.

3. Shirts made of cotton, with linen fronts, should be worn. The warm Crimean shirts (flannel) should only be used on special occasions, *i.e.*, when travelling or in an expedition. When worn for every-day purposes, they look dirty, are rather too hot, and feel heavy. The wool irritates the skin and increases the perspiration, the converse of which being what we require.

4. Collars should, when we can *legally* do so, be avoided. The shirt-band should be very free.

5. Chemises and night-gowns or shirts made of cotton material should be preferred to linen. The rule is, cotton should always be next to the skin.

6. At night use cotton sheets for covering, or if linen, lay on cotton. When the temperature is high and the bed-linen hot, cover with a thin flannel blanket.

During the hot season at M'Carthy's, when the temperature at bed-time is 100°, I have found sleeping between linen sheets to be unhealthily warm, for this simple reason, the linen easily conveys the heat to my body. Woollen and cotton are cooler, which is proved in the following experiment:—"Let two beds be placed in the same room during the day, when the thermometer stands at 90°, and let one be covered with a pair of blankets, the other with a pair of linen sheets." On removing both coverings in the evening, the bed with the blankets will be found cool. Being a non-conductor of heat, they prevent the external heat from penetrating; whilst the linen bed and the linen being a good conductor, transmitting the heat to everything beneath it, is hot.

7 Whatever hat is worn, the crown should be well protected, or covered with several folds of white turban.

8. An umbrella should always be used when obliged to go out of doors during the heat of the sun.

9. The boots should be provided with thick soles, especially during the rainy season. When wet and damp they should be immediately changed.

10. The body linen should not be changed too often; twice a-day is quite sufficient, especially amongst new arrivals.

"To change morning and evening is enough for all and every purpose, even in the hot and rainy seasons; and to change oftener is simply injurious. The property which *frequent* change of linen has in exciting the cuticular secretion, accounts for the superior health which accompanies cleanliness in our own climate, and, on the contrary, for many of the diseases

of the indigent and slovenly, which are so frequently connected with or dependent on irregularity or suppression of the cuticular discharge. But though this is true, by the injudicious, nay, injurious habits, of too frequent change of linen in a tropical climate, the fluids on the surface of the body, already in excess, are thus powerfully solicited, and the action of the perspiratory vessels, with all their associations, morbidly increased, instead of being restrained."—*Sir J. R. Martin*, "Influence of Tropical Climates," &c.

11. When caught in a rain, and the linen becomes wet and damp, it should be immediately changed, and the body sponged with hot water and vinegar or lime juice.

12. In places where dysentery or diarrhœa is prevalent, a cotton or flannel waistband should be worn, especially at night, to keep the bowels from sudden impression of cold.

II.—Food.

Rules for regulation of food.

As it is necessary to change the food when one resides in the polar regions, so as to increase the heat of the body, so it is necessary, when we attempt to reside in a tropical climate, to moderate the quantity and select the quality of our food. Since the heat predisposes to congestion and the development of febrile excitement, we should so regulate our diet as to moderate the former, whilst at the same time we neutralise the latter.

1. Before getting out of bed, or before going out of doors, a cup of tea, coffee, or chocolate should be taken.

2. The breakfast and dinner hours should be stated and regularly kept.

3. At breakfast the viands should be very simple and plain, especially amongst first arrivals, consisting of eggs, either plain boiled or poached, a little fish, unbuttered bread, and tea or coffee.

4. If the dinner be late, at a little after noon, about two o'clock, a little bread and butter might be taken, with a glass of beer (or porter preferable), or still better, draught ale. A glass of sherry or port might be taken for a change.

5. The dinner should be at about four, or half-past four; but when this is inconvenient, it should not be later than seven o'clock. It should be the principal meal, and should not be too heavy, in order to ensure a natural and refreshing rest.

6. Suppers ought always to be avoided in the tropics, where a good rest at night is essential for the preservation of the health and vigour of the mind and body.

8. When dinner is taken early, tea or coffee should be taken at seven or eight, and will be very much relished.

9. Excess in eating and drinking should be particularly avoided; excess will be known by a general feverish sensation after the meal. Dr Clark truly states that much of the suffering of the Europeans on the Gold Coast is occasioned by overfeeding.

10. The sub-acid fruits, such as oranges, pine apples, and grenadillas, will be found very agreeable and refreshing. But the European on his first arrival should carefully watch the effects of the various delightful tropical fruits which he eats, as they act differently on different constitutions. He should gradually select those which are suitable to him. Thus the mangrove is said to be stimulating and heating, and might, in an unseasoned European, bring out pustular eruptions or boils; the plantain, even when ripe, is astringent, and consequently not well adapted for those who are habitually constipated. Oranges (sweet) are always wholesome taken in the morning or afternoon, and so is the banana. In a previous chapter I have described fully the fruits found in intertropical Western Africa.

11. Unripe fruits should be avoided, especially in places where dysentery and diarrhœa or cholera is rife.

12. Condiments or spice should not be used by new comers in the tropics; they should not force their stomach, with an already good appetite, to increased and unnecessary action. When, however, by long residence the tone of the general constitution and of the stomach begins to fail, then their use will be beneficial.

III.—Drink.

General observations.

It is a physiological fact that a man in good health does not require the use of wine or spirits, or any stimulating liquor. It produces no beneficial result in his constitution, and in the tropics acts rather injuriously, even in small quantity, by increasing that febrile state of excitement which is the consequence of the heated atmosphere. Indeed "during the first two years of residence, at least, the nearer we approach to a perfect *aqueous* regimen in drink, so much the better chance have we of avoiding sickness, and the more slowly and gradually we deviate from this afterwards, so much the more retentive will we be of that invaluable blessing Health." It has become the habit of some men in the tropics, on opening their eyes in the morning, to have a "good stiff shot of brandy" the first thing before rising; and I have seen cases where a bottle of brandy has been nearly consumed before breakfast. Nothing is so injurious to the constitution as this habit. It does not at all satisfy the thirst, but leaves a desperate degree of craving for the bottle—the bottle, which, in many cases, never ends until delirium tremens supervenes.

Sir R. Martin has given a most instructive example of the different effects of aqueous and spirituous drinks and liquors in increasing or decreasing the thirst, which we will here quote *in extensio,* as it may prove beneficial to many who have made up their minds to reside in the tropics:—

"We will suppose two gentlemen to be sitting in a room, in the East or West Indies, just before the setting in of the sea breeze, both complaining of thirst, their skin hot, and the temperature of their bodies 100°, or two degrees above the natural standard. One of them, pursuant to the instructions of Dr Currie, who never was in a tropical climate, applies to the negus, beer, or brandy-and-water cup, and after a draught or two, brings out a copious perspiration, which soon reduces the temperature to 98°. It will not stop here, however, nor will the gentleman, according to the plan proposed; for instead of

putting the bulb of the thermometer under his tongue to see if the mercury is low enough, feeling his thirst increased by the perspiration, he very naturally prefers a glass or two more of the same stimulating draught, 'to support the discharge'—still, however, 'stopping short of intoxication.' Now, by these means the temperature is reduced to 97° or 96½°, in which state even the slight, and otherwise refreshing chill of the sea-breeze checks more or less the cuticular discharge, and paves the way for future maladies.

"Let us now return to the other gentleman, who pursues a different line of conduct. Instead of the more palatable and stimulating drinks he takes a draught of plain cold water. This is hardly swallowed before the temperature of the body loses, by abstraction alone, one degree of heat at least. But the external surface of the body, immediately sympathising with the internal surface of the stomach, relaxes, and a mild perspiration breaks out which reduces the temperature to its natural standard, 98°. This simultaneous relaxation of the two surfaces completely removes the disagreeable sensation of thirst; and as the simple 'antediluvian beverage' does not possess many circean charms for modern palates, there will not be the slightest danger of its being abused in quantity, or of the perspiratory process being carried beyond its salutary limits. Nor need we apprehend its being neglected, since from the moment that the skin begins to be constricted, or morbid heat to accumulate, the sympathising stomach and fauces will not fail again to warn us, by craving the proper remedy."

Rules for regulation of drink.

1. New arrivals in the tropics should refrain as long as possible from all heating drinks, especially in places where good water can be obtained.

2. If not subject to constipation, cold tea will be found agreeable and refreshing.

3. Where vegetables are not plentiful, weak lemon juice is necessary now and then; when taken in the afternoon it diffuses a coolness all over the body.

4. Sherbet will be found salutary, and any quantity may be taken, as it is wholesome and grateful.

5. Any quantity of ice might be taken ; it is not only agreeable and salutary, but it revives the spirits, strengthens the body, and assists digestion.

6. When aqueous regimen cannot be kept, the best and lightest wine that could be safely used is good claret (and water).

7. For those of weak constitution a glass of porter in the afternoon is very strengthening, and in the tropics is better than bottled ale.

8. Brandy is unnecessary ; it increases the febrile excitement of the body to a marked degree, which is followed by a corresponding depression of the vital functions. It should only be used when prescribed by the medical attendant.

9. When, after long exercise before dinner, or hard bodily exercise, it is found on sitting at table that the appetite is gone, take a glass of sherry and bitters, and this will excite the action of the stomach.

10. Warm tea or coffee after severe marches in the sun will be found a refreshing beverage (Martin).

11. A newly arrived European in the tropics should never attempt to imitate the old residents in the use of the magic bowl. He must always consider, that what the old topers can take with seeming advantage, will prove death to him.

12. During seasoning, when a course of temperance has been fully entered on, under no consideration must an occasional debauch be committed, as the system is very much subject to endemic and epidemic tropical diseases (Martin).

IV.—Exercise.

Rules for regulation of exercise.

Exercise, to the extent in which it is taken in a temperate climate, is here to be avoided, as it will soon prove injurious to the constitution. The object of exercise in a cold climate is to keep up a just balance of the circulation, to support and maintain the function of the skin, and to promote the different

secretions of the body; "but the perspiration, biliary, and other secretions, being already in excess in equatorial regions, a perseverance in" the European habit of exercise "would prove highly injurious, and it often does so, by promoting and aggravating the ill effects of an unnatural climate." Debility follows, then diminished action of the skin and visceral secretions, and then an "inequilibrium of the blood." Again, it is injurious to take no exercise at all, for it is equally necessary for the due performance of all the functions of the body that a certain amount of exercise should be taken.

1. New arrivals, in places where there are good roads, should take gentle exercise on foot every evening. It should on no account be fatiguing.

2. In the damp and rainy season exercise in the morning should never be taken. Due time should be allowed to the sun to disperse the malaria which accumulates on the surface of the earth.

3. In houses where there are long piazzas or verandahs, a walk within them in the morning will be found strengthening and agreeable, and not at all injurious.

4. Passive exercise on horseback is strengthening to the young, and with new arrivals will give a gentle impulse to the functions of the whole body.

5. Dancing, except for a short time in the cold months, is injurious. Every dancer in the tropics knows too well the feeling in the whole system, after a dance continued throughout the night.

6. Passive exercises, in carriages or palankeens, is very serviceable to those who have long resided in the tropics, and whose circulation is very languid.

7. With children hoop-racing is an agreeable and bracing exercise, as it exercises both the mind and the body.

8. Shampooing is both useful and salutary, it invigorates the circulation after fatigue or long inaction, and excites the insensibility of the cuticular secretion (Martin).

9. Before dinner one hour's repose is very salutary, and

places the stomach in a condition most favourable for the reception of food.

10. On no account must exercise be taken under the rays of a noon-day sun, or when the sun's rays can be felt.

11. Walking out in the night should always be avoided; it is injurious in every respect.

Dr Macculloch, in his work on Meteorology, says truly that "no one fears a summer evening, or even a mild winter night, unless, indeed, he finds a dew. Yet here lies the very danger. A land of meadows, and parks, and ponds, and rivers, and woods, is a thousand times more hazardous than all the nights of all the winters that ever were. This is the real night air to be feared, even though the grey mist should not rise or the dew should not fall. To take a pleasant evening walk by the banks of the river, or the lake, to watch the trout rise at the evening flies, to attend the milking of the cows in the green meadow, to saunter among wet groves until the moon rises, listening to the nightingale—these, and more of such rural amusements and delights, are the true night air, the malaria, and the fever."

12. The swing is an exercise which will be found grateful and salutary, especially if done in-doors when it is rainy. It will relax the cutaneous vessels, and produce a determination to the surface, and consequently very beneficial, especially to those who are suffering from torpidity (Martin).

V.—Bathing.

Rules for regulation of bathing.

Mr Erasmus Wilson, in his excellent "Treatise on the Skin," has laid the aphorism of health to be, "by food, by raiment, by exercise, and by ablution, to maintain and preserve an agreeable warmth of the skin." Cleanliness, says the sacred writer, is next to godliness. In no climate is there a greater necessity for the performance of good ablution than on the West Coast of Africa. The enormous calls on the cutaneous vessels, which result in an excessive discharge of their secretion, lead to an accumulation of extraneous matter on the surface, which,

if not removed, produces a mischievous effect on health. The stomach is at first disturbed, and then a series of disturbances take place, which involve most of the viscera of the body. Regular ablution, therefore, is a necessity in the tropics; but there are certain rules which must be laid down for the observance of those who reside in the tropics.

1. In the tropics a bath should be taken once at least every day.

2. The best time for taking a bath is an hour or half an hour before breakfast. The body is then cool and the stomach in excellent condition for the morning repast.

3. When a bath is taken twice a-day, the bath, which must always be cold, should be taken an hour or half an hour before dinner. It is very refreshing, especially after a hard day's work, removes the sensation of thirst in the stomach through sympathy with the skin, and, in a great measure, mitigates nervousness.

4. With the *temperate* and *healthy* the cold bath should always be taken. It is delightful, and advantageous in keeping the skin cool and moist, and reducing the sense of internal fulness.

5. Amongst the *intemperate* the cold bath is dangerous, and should not be indulged in. The tepid bath will be found more serviceable.

6. To persons suffering from visceral diseases the tepid or warm bath is the only safe bath that could be used with advantage, and once a-day is quite sufficient.

7. During the cold weather, and at the blowing of the harmattan, to persons who have suffered from enlargement of the spleen and liver, from dysentery and chronic diarrhœa, a warm bath is a necessity.

8. The relative temperature of the baths should be as follows :—"Cold bath, from 60° to 75°; tepid bath, from 85° to 92°; warm bath, from 92° to 98°; hot bath, from 98° to 112°.

9. During the hot weather, when the temperature in the sun ranges from 120° to 140°, the cold water should be kept in

the sun for some time, and an agreeable tepid bath will be obtained.

10. Amongst habitual topers, and those who are in the habit of keeping late hours, whose abdominal viscera, in consequence, are in an irritable state, and the balance of whose circulation is disturbed, the cold bath immediately aggravates the symptoms, and leads to fearful congestion. The warm bath is a necessity.

11. Before using the cold bath, it is not necessary to wait until one is *cooled down* first. Amongst the delicate it is beneficial to be first immersed in a warm bath before plunging into the cold, which will produce a healthy reaction (Martin).

12. We find it the habit of many to take a bath a few minutes after their meals. This is injurious, and should be avoided, as it interferes with the process of digestion, and might result in functional derangement of the stomach.

VI.—Sleep.

Rules for regulation of sleep.

Good sound sleep is necessary for the enjoyment of good health in the tropics. Those who have habituated themselves to going late to bed predispose their constitution to every form of disease, and put a limit to their earthly existence. It must be remembered that temperament has a great influence in the extent and manner of our sleep. The great physiologist, Dr Carpenter, says, "A plethoric habit of body, sustained by full diet, usually predisposes to sleep, provided that the digestive powers be in a vigorous condition. Persons of this constitution frequently pass nine or ten hours in slumber, and maintain that they cannot be adequately refreshed by less. On the other hand, thin, wiry people, in whom the nervous temperament predominates, usually take comparatively little sleep, notwithstanding the greater activity of their nervous system when they are awake; but their slumber, while it lasts, is generally very deep. Persons of 'lymphatic' temperament, heavy, passionless people, who may be said to live very slowly, are usually great sleepers. But this is rather because, through

the dulness of their perceptions, they are less easily kept awake by sensorial or mental excitement, than because they really require a prolonged cessation of activity."

1. Regularity in the hours of going to sleep is very important in the tropics. Between nine and ten will be found the best time.

2. The apartment should be cool, and every means adopted to keep it so; but the individual should be completely kept from draught, and from the sudden changes of temperature and the humidity of the atmosphere which is peculiar to the tropics.

3. Every circumstance by which the sleep can be disturbed should be obviated. Thus, in places where mosquitoes and sandflies are prevalent, proper curtains should be used.

4. It is always most preferable and desirable to go to bed with a clear head. The habit of much drinking at night disturbs the sleep and renders it unrefreshing.

5. Those who are habituated to late hours and bacchanalian riots, will find themselves much relieved from the after consequences of the imprudent habit by bathing their head with cold water before going to sleep.

6. Reading late at night in the tropics is a habit not to be encouraged, for the nervous system has enough of excitement during the hot and busy hours of the day, and requires repose at night.

7. When there is a feeling of tension, heat, headache, throbbing, and other unpleasant sensations in the head, we should lie down quietly, and endeavour to get a sleep, for it is certain that something wrong is going on in the brain, and rest and quietude are most likely to relieve it.

8. Sleeping until too late in the morning, when the sun has ascended to a great distance above the visible horizon, produces lassitude and want of energy in individuals in the tropics.

9. Rising at daylight and enjoying the fresh and cooling breeze of the morning, in a verandah, or beyond the reach of malaria, is very healthy and invigorating.

10. During the blowing of the hot simoom, in the hot season, in the interior of the Gambia, or the sirocco of the east, when no dew falls, sleeping in open verandahs is not only safe, but advantageous. On the other hand, during the rains, the harvest, and harmattan, such a habit will be found most destructive to life; in fact, there are many cases in the Gambia where men, whose names I might mention, have continually exposed themselves in this way, contrary to all advice of their friends, and thus laid the foundation of acute diseases, which have proved their death-warrants.

11. The dyspeptic, namely, those who suffer from flatulency, heartburns, and griping pains, are occasionally troubled with nightmare, which disturbs their rest. They should take carbonate of soda and a little peppermint, and always keep their bowels regular.

12. Late suppers, cheese, and other flatulent food, and all indigestible fruits, should be avoided at night. This rule is particularly incumbent on the dyspeptic.

VII.—Regulation of the Passions.

Rules for government of the passions.

Moseley, quoted by Martin, has said that in the inhabitants of hot climates there is a promptitude and a bias to pleasure, and an alienation from serious thought and deep reflection, unless sickness obtains an absolute control over the body. "The brilliancy of the sky and the beauty of the atmosphere," he observes, "conspire to influence the nerves against philosophy and her rigid tenets, and forbid their practice among the children of the sun." The effects of great heat on these "children of the sun" I have considered at some length in Chapter III.; but I think Sir Ranald Martin has hit the right string, when he says that the "removal of religious and moral restraint, the temptations to vice, the facility of the means, and the force of example, are the real causes of this bias to pleasure."

That able observer has truly and feelingly pointed out where the real cause of this *propensity* is to be found. "The monotony of life," he says, "and the apathy of mind so con-

spicuous in hot climates, together with the obstacles to matrimony, too often lead to vicious and immoral connections with native females, which speedily sap the foundations of principles imbibed in early youth, and involve a train of consequences not seldom embarrassing, if not embittering every subsequent period of life. It is here that a taste for some of the more refined and elegant species of literature will prove an invaluable acquisition for dispelling *ennui*—the moth of mind and body."

1. A strict moral principle is beneficial in the tropics.

2. The Christian religion has a more beneficial influence on the minds of men in the tropics than either Mohammedanism or any other religious tenets.

3. Slothful and squalid habits should be avoided. The saying is true that "a *slothful, squalid-looking population invariably characterises an unhealthy country.*"

4. Every substance or circumstance which induces nervousness and excitability of the nervous system should be avoided.

5. Persons accustomed to licentious indulgences are to be avoided, especially on first arrival.

6. Always keep the mind occupied in doing something; never sit down and allow the thoughts to go astray.

7. Agreeable society should always be courted, as it relieves the mind a great deal. The society of real ladies will be found preferable to any other.

8. The occupation of lofty buildings, or buildings in elevated portions of a town or city, has a very beneficial effect on the mind. The converse is also true.

9. In order that the moral principles might be more easily kept, the new arrival should watch over and prevent any laxity in habits or principles acquired in his early religious training.

10. The companionship of persons of irritable and violent temper should, as much as possible, be avoided, as in the tropics such habits are peculiarly catching, and have an injurious effect on the health.

11. Too hot diet, or hot condiments taken in excess, have an injurious influence on the passions.

"The use of certain kinds of food and drink may tend to confirm or impair certain moral habits. Sometimes it may operate directly, and by the immediate impressions which it produces; at other times by the different states of health or disease which it occasions, or by the changes in the fluids and solids which result from it; for all these different alterations in the system soon manifest themselves more or less distinctly in the ordinary dispositions of the will and understanding" (Canabis).

12. A poor diet and a simple vegetable diet affects the passions injuriously, and therefore should be avoided.

"The poor diets prescribed by the legislators of various religious orders have never had the effect of diminishing the venereal appetite, but have, on the contrary, inflamed these propensities the more, or disordered the imagination in diminishing the physical forces; and thus men have been rendered more feeble, more unhappy, and more easy of domination" (Canabis).

Before concluding this part of the work, I shall here detail certain precautions necessary for the prevention of some of the diseases peculiar to tropical climates.

I.—Malarious Fevers.

Rules for prevention of malarious fevers.

From the foregoing chapters it will be seen that malarious fevers are most common in districts which are ill drained, and abound in stagnant marshes and collections of decayed vegetation; that they hover about the banks of rivers, the borders of marshes, the edges of pools; that they predominate very generally in the neighbourhood of pig-styes and badly-constructed drains, and take special delight in the incense of putrefying animal matter; that they are repugnant to fresh air, and when left to themselves, will linger for years amidst scenes of filth and corruption, and fold in their deadly embrace all human beings who are so unfortunate as to be thrown into their company. As a preventive, then, the *primum mobile*

of our action should be to drain the land, to use stringent means for preventing the accumulation of decayed vegetable or animal matter, and, consequently, to put a stop to all miasmatic effluvia or exhalation.

With regard to the individual who must be exposed to malarious fever, or " who has once had the fever," says Dr Watson, " he should, in whatever place he may happen to be, avoid exposure to extremes of cold and heat, and the neglect of changing wet clothes—wet shoes and stockings, for instance.

" In malarious districts, in tropical climates, for example, persons should bear in mind the fact, that the miasmata are much more virulent in the night time than in the day, and closer to the surface of the earth than in the higher strata of the atmosphere. They should refrain, therefore, from going out late in the evening, or early in the morning, in countries where ague is rife; should take care not to go out fasting; a good hot breakfast should be first taken, or, at any rate, some moderate stimulant. A crust of bread, or a glass of wine, or a small quantity of ardent spirits, will fortify the system against the pestilential miasma. Generous diet and fair allowance of fermented liquor are proper, also, for all persons in aguish countries."

To substantiate the fact that good living is a safeguard against malarious fevers, I will add an example which I noticed in the late Ashantee expedition with an officer of the 1st West Indian Regiment. Lieutenant S—— arrived at the encampment at the Praah on the 30th April, full of strength and vigour, having just arrived from the West Indies in the transport. Ten other officers came up with him. Unfortunately, he was not only a vegetarian but a water drinker. He was able for a week to attend to the duties of the camp, after which he gradually became weaker. The countries around the encampment had not in cultivation vegetables which contained a sufficient amount of protein compound necessary for his nourishment. He was the first laid up, and he had a most

severe attack of malarious remittent fever; and only ten days after his arrival I was obliged to send him down to the coast, where for many weeks he lay in a precarious state, and for a long time still refused to take any meat or wine. Seeing the dangerous state into which he had brought himself, he altered his creed, and began to take beef tea, chicken broth, and wine, which rallied him a great deal; but his constitution being too weak and prostrated, he gained strength very gradually; and fearing a relapse which might prove fatal, he was invalided to England.

I should strongly recommend that persons who reside in malarious districts, or who in any way are exposed to the influence of malaria, should now and then take the sulphate of quinine, as it serves as a preventive; or should the person be attacked, he will have a milder and more manageable disease than another who has not been so protected. For the very valuable maxim, which every one knows either from personal experience or from that of others, should be followed, which is conveyed in the homely proverb, *Prevention is better than cure.* Better, did I say? Infinitely better, because it unshackles the system from those concomitant miseries which would otherwise have fettered it. The best mode of giving quinine for such a purpose is in the form of quinine wine; four grains to every ounce of sherry, of which an ounce should be taken every morning before going out, and repeated, if requisite in the afternoon. I shall here give one illustration, out of many which might be brought forward to substantiate this position. In 1852, an expedition was undertaken by the Admiralty for two purposes: First, of exploring the river Tsadda from Dagho, the point reached by Allen and Oldfield in 1833, as far eastward as possible; and, secondly, of endeavouring to meet and afford assistance to Drs Barth and Vogel. Accordingly, the iron steam-schooner 'Pleiad,' under the command of the late Dr Baikie, ascended the Niger. The Europeans on board were armed with quinine as a prophylactic, which they took whenever they had occasion to go on exploring

expeditions, and after three months' voyage in the interior of Africa, along the swampy banks of a large river, all returned safe, and in sound health. Of the effects of quinine Dr Baikie wrote, "Of the measures employed as hygienic, most were of a general nature, the only more specific one being the free use of quinine. The amount of sickness was very little, so that, except with the scorbutic cases, Dr Hutchinson's really medical duties were not onerous. Of the Europeans the most exposed to the climatic influences were Mr Harcus, Mr Guthrie, Mr May, and myself. Mr Harcus was chiefly exposed during the day, and suffered only from frequent headache, and from the effects of the sun's rays. Mr Guthrie, besides undergoing daily an immense amount of fatigue, slept regularly on deck, and nevertheless escaped entirely. Mr May and I were ashore whenever opportunities occurred, and as often by night as by day. We had frequently to land in swamps, and other unhealthy spots, yet Mr May had only one very short and not severe febrile attack. I, in addition, always slept on deck, and was roused regularly at twelve o'clock, and three in the morning, for the purpose of recording meteorological observations, but while in the river I had *constant* health. I mention these circumstances," he goes on to state, "to show that, under *proper precautions*, Europeans may not only live quietly, but even commit with impunity what some years ago would have been considered a terrible indiscretion."

Among other things that should be guarded against is the too frequent use of drugs, especially calomel, and other mercurials, which have *actually killed far more people in bygone years in tropical climates than even fever.* "Calomel has no real or curative effect on malarious poison, but only adds fuel to the fire, as the unfortunate to whom it is administered has to contend against two poisons rather than one." Avoid, also, too liberal use of intoxicating liquors.

Additional precaution for yellow fever.

Additional precaution is necessary, especially in the navy, when an invasion of YELLOW FEVER is threatening. For individual safety the comprehensive maxim of Celsus should always

be consulted, viz., *by timely avoiding the various predisposing and exciting causes, until the physical sensibility of the system is reduced by habit;* and in proportion as this advice is adhered to, the naval practitioner may be assured that not only the chance of sickness will be greatly diminished in his own person, but that in a well-regulated ship, aided by the earnest and judicious co-operation of the officers, the lives of the men under his charge may be preserved to an extent beyond his expectations in ordinary seasons and circumstances. He must always remember that the prevention is more important than the treatment.

"The most speedy means of prevention," says Sir J. R. Martin, "in respect to towns and garrisons will always be found in the removal of both the sick and the healthy to a locality where the temperature is sufficiently low, such as a neighbouring elevated range, or dry, well-ventilated ground. The next most ready means is segregation."

Quinine should be used twice a-day, and should be continued for a longer or shorter period, as may be found necessary. The other necessary naval precautions may be thus epitomised. "Whenever fever makes its appearance on board ship, the vessel should at once proceed to sea, and to the coolest atmosphere within reach."

The most immediate measures of prevention should be to alleviate direct solar exposure, to prevent fatigue, and excesses in the use of spirituous and fermented liquors.

Seamen should be kept as remote from unhealthy coasts as is consistent with duty, anchoring some miles out to sea during the night especially.

Duties in boats should be conducted during the mornings and evenings, avoiding alike the noon-day heat and the deadly emanations from the shores common to the night.

When men are landed a careful and well-selected encampment should be chosen on high and dry ground.

Meals should be regularly served and carefully cooked, and no more spirit ration should be issued than is customary.

Coffee should be given early in the morning as a habit, and after unusual fatigue, cold, wet, or mental depression; and labour ought not to commence till coffee has been taken.

Holds of ships should not be cleaned on the spots where the fever has originated, or during its prevalence, but the cleaning should be deferred till the arrival of the vessel in a colder latitude.

Green wood should not be placed on board ship in hot climates. It ought to be *barked*, and partly *charred*.

The inhabitants should use a nourishing but not stimulating diet, and should maintain a cheerful and confident temper.

Never go to an infected spot with an empty stomach, or when the body is exhausted by fatigue and perspiration.

Those who are accustomed to drink a large quantity of beer should give it up. Sherry or port, or a little brandy and water, will be found more serviceable, and less likely to excite the liver.

When there is a suspicion that yellow fever is approaching, the strong, robust, newly arrived individuals should at once be put to sea, or removed to a climate where the temperature is not above 60° F. If this is impossible, they should seek a mountain retreat where thorough ventilation is certain to be secured by strong winds; or remove to the borders of the sea, where the strong sea-breeze is able continually to sweep the foul air generated from the soil. They must always remember that they are the most susceptible to attack.

II.—Dysentery and Diarrhœa.

Celsus has truly remarked, that by timely avoiding the predisposing and exciting causes, we have a great power of preventing the disease. I shall here give the predisposing and exciting causes without making any remarks, leaving my readers to deduce the prevention. Causes and prevention of dysentery and diarrhœa.

PREDISPOSING CAUSES.

1. Frequent attacks of intermittent and remittent fever.

2. Long and fatiguing marches.

3. Salted and preserved provisions.

4. The want of a sufficient supply of fresh vegetables and fruits.

5. Impure water, or water impregnated with vegetable and animal matter.

6. Too frequent use of drastic purgatives.

7. The use of ill prepared, indigestible, or unwholesome diet.

8. Retained secretions ; endemic and epidemic influences.

9. Diseases of the spleen and liver.

10. Overcrowding in confined places.

11. Excessive mental depression.

12. Impure air, or air contaminated with organic effluvia.

EXCITING CAUSES.

1. Eating of unripe fruit.

2. Variation in the temperature.

3. Cold night air, and exposure to wet and cold.

4. Worms.

III.—Cholera.

Prevention of cholera.

The prevention of cholera is a most important subject, and, in countries where the disease is occasionally epidemic, it deserves the consideration of every one.

Regulations of French Council of Health.

During the outbreak of 1865 the Public Council of Hygiene and Salubrity of Paris for the Department of the Seine, published a series of admonitory instructions and recommendations, of which the following is an abstract:—

1. Tranquillity of mind.

2. Moderate, healthy, and regular nourishment.

3. Clothing which will prevent exposure to sudden transitions of temperature.

4. Free ventilation of dwelling-houses, and avoidance of over-crowding.

5. Avoidance of physical and mental fatigue.

6. Attention to the earliest symptoms of diarrhœa.

The instruction continues, It may be affirmed that, with rare exceptions, however sudden the attack may be, the cholera is yet preceded by symptoms which may induce fear as to its development. The commonest of these symptoms is diarrhœa, however slight; and such is its importance, that the removal of the symptoms, immediately on its development, will suffice to prevent the malady. It would, therefore, be dangerous to let the diarrhœa continue; and, consequently, as it may be arrested by every simple means, they may be resorted to before the arrival of the doctor, who ought always to be sent for without delay. Those means are the following:—Partial or complete abstinence from food, the use of rice and its preparations, an infusion of camomile tea, and copious injections with a decoction of marsh-mallow and unprepared starch.

When there are symptoms of cholera, such as watery diarrhœa, vomiting, cramps, coolness and blueness of surface, &c., the following recommendations are given:—

The instant any of these symptoms show themselves, a physician must be called for, and, while waiting his arrival, the means adopted must be the following:—The skin should be heated and warmth obtained by placing a bottle of hot water, or heated bricks wrapped in a sheet, at the feet of the patient and between the legs. He must be covered up in warm sheets and several blankets, between which hot irons or a warming-pan should be agitated up and down, so as to act upon the whole surface of the body. While these steps are in preparation, or even in progress, the limbs should be rubbed for a considerable time with force with the palm of the hand, a soft brush, or a piece of flannel, which latter may be moistened with camphorated brandy, brandy alone, or eau de Cologne; and these should be done by two persons seated at each side of the patient, taking care not to uncover him. The drink

given should be a hot infusion of linden, tea, or peppermint, tinctured with a few drops of brandy. Should these tisanes, however, appear to increase the vomiting, gaseous water and ice in small pieces may be advantageously resorted to, and sinapisms down over the legs and thighs. It will always be well, if possible, to let the patient be in a separate room, so as to place him in the most favourable conditions for salubrity. The precautions to be taken during convalescence will be intimated by the physician who may be called.

Regulations of Dr Clark, 84th Regiment.

Dr Clark, of the 84th Regiment, anticipating the cholera outbreak in Malta, drew up the following series of regulations for the guidance of the officer commanding:—

"1. Perfect cleanliness of barracks and immediate neighbourhood.

2. Careful inspection and purification of drains, privies, and ashpits.

3. Ventilation of barrack-rooms at all times, and airing of beds and bedding, with rubbing and brushing of walls and floors every second day.

4. Care in selection of vegetables for consumption, and discouragement of eating ices.

5. Use of a cholera belt.

6. Hot coffee to be issued to each man before leaving quarters in the morning. Men suffering from diarrhœa to go into hospital at once.

7. Troops to be prohibited from visiting infected neighbourhoods.

8. On cholera appearing in any portion of the barracks then occupied, it is to be vacated at once, and the force attacked to be removed into other barracks or camped out."

Regulations of College of Physicians of England.

In the present outbreak (1866) the College of Physicians has given the following instructions for the treatment of cholera:—

"The Lords of her Majesty's Privy Council having, by their medical officer, Mr Simon, addressed a letter to the College of Physicians relating to the expediency of issuing instructions

to captains of merchant vessels, 'how they should act when proper medical attendance cannot be procured, so as to provide for the health of their crews against attacks of cholera,' the following is the substance of the reply forwarded by the College:—

Their lordships request to be informed whether, in the opinion of the College, any, and if so, what suggestions might be issued as representing the present state of medical knowledge and experience with regard to the drugs which should be given, or other treatment which should be adopted, in attacks of cholera, and especially in the beginning of the disease, when proper medical attendance cannot be procured. Their lordships, at the same time, submit to the College a copy of the instructions issued on previous occasions. With reference to that part of the instructions on which their lordships particularly request the opinion of the College, viz., that which relates (1.) to the necessity of avoiding purgative medicines during the prevalence of cholera, and (2.) the measures to be adopted when cholera appears on board ship, the Committee think—

1. That when opening medicine is required, the mildest should be selected, as castor oil or rhubarb. Glauber's salts and Epsom salts are dangerous. The common belief that prolonged costiveness should not be interfered with during the prevalence of cholera is erroneous.

2. That the master should ascertain by inquiry, morning and evening, whether any of the crew are labouring under diarrhœa; and if so, the following recommendations are subjoined for his guidance:—

3. That if a man be attacked with diarrhœa, he should, whenever it is possible, be sent to bed and kept warm, and some aromatic and astringent medicine, containing a small quantity of opium, should be given to him at once, and should be repeated every hour or two, according to the severity of the purging. It is suggested that ten grains of the aromatic powder of chalk and opium (of the "British Pharmacopœia")

should be so given in half a glass of peppermint water or weak brandy and water. Should this medicine not be at hand, five measured drops of laudanum may be substituted for each dose of the powder.

Large doses of opium, or of ardent spirits, should be avoided. If the diarrhœa should result from bad or obviously indigestible food, or if the discharges are unnaturally offensive and attended with griping pain, it would be desirable to give a dose of either of the gentle laxatives above-named before administering the opiates.

The diet should consist mainly of beef tea or broth, gruel, or rice.

If the discharges become colourless and watery (the purging being of the kind commonly called "*rice water purging*"), and be accompanied with vomiting and coldness, the opiates should no longer be persisted in, and spirituous liquors should be avoided. The patient should be strictly kept in the recumbent position; he should be allowed to drink water freely, and should be abundantly supplied with fresh air. Warm applications should be used to the feet and legs, and a mustard poultice should be applied to the pit of the stomach. Cramps may be treated by rubbing the affected parts with the warm hand.

In all cases medical advice, when obtainable, should be obtained as soon as possible."

Instructions of Minister of War of England, 1866.

The following INSTRUCTIONS to *commanding, medical, and other officers of the army,* for their guidance at a time when there is reason to anticipate *an outbreak of cholera,* or when it is *actually prevalent among the troops,* has just been received by the author (September 1866):—

"Officers whose duty it is to see to the health and comfort of the troops are especially required to exercise the utmost vigilance at a time when cholera is prevalent, or when there is reason to believe an outbreak may be expected."

"MEASURES TO BE ADOPTED IN ANTICIPATION OF A THREATENED INVASION OF EPIDEMIC CHOLERA IN MILITARY STATIONS.

I. Medical officers should make themselves acquainted with every arrangement of their corps, and the condition of every locality in and about the barracks, in order that they may be in a position to suggest, for the consideration of their commanding officers, not only improvements in ordinary matters, but arrangements of a more temporary character applicable to an exceptional period.

II. Nuisances should be removed, and cleanliness enforced *outside* barracks, by calling on local boards, or persons entrusted with power to remove nuisances, to put these in force.

III. As much space as is practicable should be afforded to each individual in barracks. On this account any existing misappropriations should be restored to their proper use.

IV. Ventilation of all the buildings should receive careful attention, not only by remedying structural defects when practicable, but by enforcing the full use of the means of ventilation, in keeping open all apertures intended specially for ventilating purposes.

V. The instructions laid down in the Queen's Regulations regarding the cleansing and supervision of barrack-rooms are to be carefully observed. The floor of the rooms should not be washed in wet weather. The regular airing of bedding, and its exposure out of doors in fine weather, is to be attended to. And if epidemic cholera appears in the country, it would seem desirable to cleanse and lime-wash ceilings and walls of all barracks, hospitals, quarters, and stables.

VI. All sewers, latrines, urinals, and ash-pits should be inspected frequently, and their cleanliness ensured by an efficient system of frequent flushing and cleansing. Any accumulation in such places should be scrupulously removed, as it must be borne in mind that during the prevalence of an epidemic it is injudicious to disturb old accumulations. A free use of lime is enjoined.

VII. Every source of water supply should be investigated, and the possibility of contamination by percolation from sewage, or from surface impurities, looked to. An examination should be made of the water, and any such impurities detected in it should at once preclude its use for drinking or cooking purposes.

VIII. Attention is to be directed to the soldier's rations, and care taken that they never fall below the standard quality; and the men are to be enjoined to be careful as to what they eat, and the purchase of any articles deemed indigestible or deleterious to health should be discouraged as much as possible.

IX. As much variety as possible is to be afforded in the cooking of the rations.

X. The canteen is to be frequently visited, and its supplies carefully examined.

XI. It is unnecessary for medical officers to recommend any change in the ordinary duties of the men, as long as they are not excessive, beyond suggesting the advisability of reducing the night duties to the minimum that the necessities of the station will permit, and pointing out to the commanding officer, that any duty subjecting the men to wet clothes or wet feet should be avoided when possible, and when such exposure is unavoidable, that the wet articles should be changed as speedily as possible.

XII. Medical officers should make frequent inquiry as to the existence of diarrhœa amongst the men; and in the event of affections of the bowels being prevalent, should enjoin an immediate application to hospital for medicine, not necessarily with the view of the men being detained in hospital.

In addition to the foregoing instructions, when the disease has appeared among the inhabitants in the vicinity of a military station, or among the military of the station, the following are to be carefully attended to:—

I. The occurrence of cholera in places where troops are stationed is immediately to be reported to the Director-General by the principal or senior medical officer, without waiting for

its appearance being officially announced by the local board of health.

II. A daily report, as accurate as can be obtained, of the progress of cholera amongst the civil population where troops are stationed, will also be required from the principal or senior medical officer.

III. The men should be prohibited going into the infected districts, pickets should be placed to prevent them. It may be advisable to confine the troops to barracks, and prohibit any but the most necessary intercourse with persons outside.

IV. All families living out of barracks should be brought in, if it be possible to do so without over-crowding. If the season permitted they might be encamped, or if there were danger of overcrowding, houses admitting of partial or complete isolation might be hired.

V. Men rejoining from furlough, or under any circumstances from a distance, or recruits arriving, are to be separated from the other men for at least a week.

VI. Good fires are to be provided in the barrack-rooms to increase ventilation, and to diffuse a cheerfulness, which last should be promoted in every way.

VII. Disinfectants, such as chloride of lime or zinc, preparations of carbolic acid, perchloride of iron, or other approved preparations, should be used in latrines, urinals, sewers, ash-bins, and other similar places, twice daily. A non-commissioned officer with a fatigue party should be instructed in the performance of this duty, which is to be rigorously carried out, and either the quarter-master or orderly officer should be held responsible for its execution. Disinfectants will be obtained from the barrack department on the spot.

VIII. Married men (if out of mess) should each be provided with a ration the same as the single men.

IX. The men are to be cautioned against intemperance, and every means adopted to repress it, and night passes must be prohibited.

X. Tea or coffee is to be issued to the men before going on

morning or night duties; and every man to have his breakfast, if possible, before leaving the barrack-room for parades or other duties.

XI. On the occurrence of a case of cholera among the troops a report is to be forwarded by the senior medical officer to the Director-General, and continued daily until further orders.

XII. Questions of importance not admitting of delay may be telegraphed to the Director-General by the principal medical officer.

XIII. On the appearance of cholera in a corps, it should be camped out when practicable, provided the season of the year will permit of it. Good ground should be selected beforehand, and arrangements made by the Quarter-master General's department.

XIV. Health inspections are to be made at morning and evening parades, and a daily inspection of every individual attached to the regiment, but the avoidance of all unnecessary alarm cannot be too strongly enjoined.

XV. Each soldier is to be provided with two cholera belts as part of his necessaries. Flannel shirts ought also to be worn.

XVI. It has been found desirable, during the prevalence of cholera, to boil and filter through charcoal all drinking water.

XVII. The minds of the men should as much as possible be occupied and amused. Every game or employment tending to recreation, or to induce healthy exercise, should be promoted. Occasional marches for short distances into the country, without arms, might be advisable.

XVIII. Diarrhœa should be most carefully attended to during the prevalence of cholera, and non-commissioned officers are to be instructed to order all men to hospital whom they may detect suffering from looseness of the bowels. Sentries should be placed in the vicinity of the latrines, and men found going twice in quick succession to the rear should be sent to hospital immediately. It might be advantageous for the better detection of this usually painless affection, that

tickets be provided for the men, and every time a man went to the rear one of them handed to the sentry; but a man not having his ticket should be allowed to pass, and his name reported to the orderly sergeant. A room for observation in hospital should be provided for such men, and their motions treated as in the case of cholcra patients. Medicines are to be kept prepared for issue to such cases, day and night, and, to avoid delay, a supply should be placed in the hands of non-commissioned officers in barracks, to be exhibited to men while preparing to go to hospital.

XIX. The place whence a patient is taken from barracks is to be thoroughly washed, the bedding and bedstead removed, and fumigation made by chlorine or nitrous acid gas. The barrack bedding is to be removed with cholera or suspicious cases to the hospital.

XX. If, however, it is found that any preponderance of cases of cholera or diarrhœa occur in any building or rooms, the medical officers should carefully examine the locality with a view to detecting or remedying any unsanitary condition. Should such be appreciable either in the building or its vicinity, the building or room should be vacated and fumigated with chlorine, nitrous, or sulphurous acid fumcs, and the walls and floors scraped and cleansed, and the former lime-washed before reoccupation.

XXI. When cases occur in camp, the ground should, if possible, be changed, as so successfully practised in India; but where this may be impracticable, as would usually be the case at home, the tents should be struck, and the ground cleansed and aired before repitching them.

XXII. If the troops are not camped out, the regimental hospital is to be appropriated to the treatment of cholera, and the ordinary cases of sickness accommodated in barracks, in rooms set apart and equipped for the purpose, or, where this cannot be done, in a hired house—an application for carrying out the latter arrangement being previously submitted to the Director-General. Should the troops be encamped, all the sick

will be treated in tents, the tents for cholera patients being placed in an isolated position.

XXIII. Medical officers are to visit their hospitals frequently. They will be required to be always available for any sudden call on their services, and when cholera prevails in the corps, they are not to leave the barracks except under imperative necessity.

XXIV. Great caution is advisable in the use of medicines of a purgative character during the prevalence of the disease.

XXV. Cases among the wives and children of soldiers are to be treated in the female hospital, where such institutions exist, provided the regiment is not camped out. In stations where there is no female hospital, application should be made to the proper authorities for a room to be allotted or accommodation to be hired.

XXVI. The women should be warned that if they or their children are attacked with diarrhœa they must at once go to hospital.

XXVII. The patient's barrack bedding is to be used in hospital. The purveyor will provide palliasses and pillows with straw in the event of a change being requisite. All the hair mattresses and pillows are to be removed from the hospital to equip the rooms set apart for the treatment of the ordinary cases of sickness when cholera attacks the troops.

XXVIII. When the barrack bedding is no longer required for use the straw is to be burnt, and the bedding disinfected, and treated in accordance with paragraph 7, page 40, Medical Regulations (boiling water being used). The foregoing is applicable to hospital sheets, blankets, clothing, and other such articles of hospital equipment as may be used. But such portions of the soldier's kit as cannot be so treated should be exposed to the air and sun for a week, fumigated, and beaten. It would be advisable not to take them into use until the epidemic had quite ceased.

XXIX. The stool and vomit should be passed into vessels and deodorised, at once removed, and carefully buried deep,

and at a distance from the possibility of percolation to any water supply; or a latrine could be set apart into which they could be thrown, which should not for the time being be used for any other purpose, and care should be taken that no other latrine or water-closet is so used.*

XXX. The attendants upon cholera patients should not be taken from this special work to attend on other cases of disease so long as cholera exists in the barracks or hospital. They are to be enjoined to wash their hands well whenever they have been in contact with the discharges of the sick.

XXXI. Corpses are to be removed to the dead-house without delay, buried as soon as possible, but never conveyed to the graveyard on men's shoulders.

XXXII. *Post-mortem* examinations are to be performed in such cases, and under such modifications as may be necessary.

By order of the Secretary of State for War.

EDWARD LUGARD.

* The power of the dissemination of cholera by means of the excreta is now so generally believed, and has been asserted by so many eminent members of the medical profession, that it cannot be overlooked in considering preventive measures at the present day.

I.—TABLE OF METEOROLOGICAL OBSERVATIONS ON THE WEST COAST OF AFRICA. (*By the Author.*)

MONTHS.	Atmosphere.			Exemption from what Diseases.			Predisposed to what Diseases.		
	Sierra Leone, Liberia, and neighbourhood.	Gambia, Senegal, and neighbourhood.	Gold Coast, The Bights, and neighbourhood.	Sierra Leone, Liberia, and neighbourhood.	Gambia, Senegal, and neighbourhood,	Gold Coast, The Bights, and neighbourhood.	Sierra Leone, Liberia, and neighbourhood.	Gambia, Senegal, and neighbourhood.	Gold Coast, The Bights, and neighbourhood.
January, . .	Cold, bracing, and tonic, soft and agreeable.	Dry, cold, tonic, and very bracing and agreeable.	Cold when N.E. wind blows, otherwise warm and soft.	Malarious Fevers, Exanthematous Fevers, Dysentery, and Diarrhœa.	Dysentery and Diarrhœa, Malarious Fevers, Exanthematous Fevers, Ulcerations, Rheumatism, Menorrhagia.	Congestive Fevers, Hepatic Diseases, except when N.E. wind blows.	Pulmonary Diseases, Ophthalmia, Chapped Lips, Glandular Swelling.	Pulmonary Diseases, Glandular Swelling, Chapped Lips, Ophthalmia, Hepatic Diseases.	Guinea-worm, Influenza, Glandular Swellings.
February, .	Warm, dry, sometimes moist, and sometimes oppressive.	Cold, tonic, in beginning; warm, moist, latter end.	Hot and oppressive, especially latter end.	Malarious and other Fevers; Pulmonary Diseases.	Malarious and other Fevers, Disease of Lungs and Bowels.	Malarious Fevers, Chronic Bronchitis, and Dry Cough.	Bowel Complaints, Rheumatism, Exanthematous Diseases.	Exanthematous Diseases, Ulcerations of whatever kind, Bleeding.	Irritating Cough, Dysentery, and Diarrhœa.
March, . .	Dry, hot, sultry.	Dry, hot winds, disagreeable.	Dry, hot, sultry, irritating tornadoes.	Rheumatism, Inflammatory Dyspepsia, Malarious Fevers.	Rheumatism, Dyspepsia, Diarrhœa, and Dysentery.	Rheumatism, Inflammatory Dyspepsia, Guinea-worm.	Exanthematous Diseases, Diarrhœa, Prickly heat.	Ulcerations, Eruptive Diseases, Prickly heat.	Diarrhœa and Dysentery, Malarious Fevers.
April, . . .	Hot and dry at beginning, mild, relaxing, and windy towards end.	Very hot, and parching hot winds, sometimes sultry.	Hot some days, mild, soft, relaxing and windy, in others, tornadoes.	Gout and Dyspepsia, Guinea-worm.	Malarious Fevers, Diarrhœa and Dysentery, Rheumatism.	Inflammatory Dyspepsia, Guinea-worm.	Diarrhœa and Dysentery, Apoplexy, Malarious Fevers.	Apoplexy, Exanthematous Diseases, Prickly heat.	Malarious Fevers, Diarrhœa and Dysentery.
May, . . .	Moist, relaxing, rainy, tornado, damp.	Dry, hot, very windy, dirt and hot, sometimes oppressive.	Mild, moist, rainy, and damp.	Exanthema when rain plentiful, Apoplexy.	Dysentery, Diarrhœa, Hepatic Diseases, Rheumatism, Malarious Fever.	Apoplectic Disposition, Exanthema.	Malarious Fevers, Sore Throat and Neck, Hepatic and Splenic Diseases.	Exanthematous Diseases, Prickly heat, Apoplexy.	Malarious Fevers, particularly Intermittent and Remittent type, Guinea-worm.

June, . . .	Moist, rainy, agreeable in mornings.	Hot, sultry, dry, slight rain at latter end.	Cold, constant alteration of temperature, hot, sultry.	Exanthema, Apoplexy, Prickly heat.	Malarious Fevers, Rheumatism, Diarrhœa and Dysentery, Disease of Liver.	Prickly heat, Exanthema, Apoplexy.	Diarrhœa and Dysentery. Malarious Fever.	Apoplexy, Exanthema, Dyspepsia.	Malarious Fever, Dysentery and Diarrhœa, Hepatic Diseases.
July, . . .	Heavy rains, very changeable, atmosphere cold and soft.	Moist, soft and rainy, very changeable.	Equally soft and rainy.	Diarrhœa, Dysentery, Dyspepsia, Malarious Fever.	Apoplexy, Exanthema, Prickly heat.	Diarrhœa and Dysentery, severe forms of Malarious Fever.	Mild Ague, Pulmonary Diseases, Constipation.	Severe Malarious Fevers, Diarrhœa and Dysentery, Guinea-worm.	Mild Ague, Rheumatism, Guinea-worm, Constipation, Pulmonary Diseases.
August, . .	Heavy rains, cold, soft, agreeable.	Moist, soft, rainy, changeable.	Soft, rainy, moist, cold, changeable.	Dysentery and Diarrhœa, Malarious Fever (severe).	Apoplexy, Exanthema, Prickly heat.	Dysentery, Diarrhœa, Apoplexy.	Congestive Fever, Pulmonary Diseases.	Guinea-worm, Malarious Fevers, Diarrhœa, Dysentery.	Pulmonary Diseases, Guinea-worm.
September, .	Very changeable, windy, damp, unsettled.	Moist, rainy, changeable.	Still, damp, windy, and unsettled.	Dysentery, Diarrhœa, Irritating Cough of hot climate.	Very severe Malarious Fever, Prickly heat, Dysentery, and Diarrhœa.	Dysentery and Diarrhœa, Irritating Cough of hot climate.	Pulmonary Complaints, Chronic Rheumatism.	Mild Malarious Fevers, Pulmonary Diseases, Rheumatism.	Pulmonary Diseases, Guinea-worm, Intermittent and Remittent Fevers.
October, . .	Warm, moist, changeable, subject to frequent tornadoes.	Hot, oppressing, windy, subject to tornadoes.	Warm, moist, genial and mild, subject to frequent tornadoes.	Pulmonary Diseases, Dysmenorrhagia, Acute Rheumatism.	Pulmonary Diseases, Rheumatism.	Severe Malarious Fevers, Hepatic and Splenic Diseases, Pulmonary Diseases.	Intermittent and sometimes severe Malarious Fevers, Diarrhœa and Dysentery.	Diarrhœa, Dysentery, Malarious Fevers.	Dysentery and Diarrhœa, slight Intermittent and Remittent Fevers.
November, .	Hot, not oppressive, windy, some tornado.	Hot in beginning, soft, mild towards the end.	Dry, hot, somewhat oppressive, relaxing, some tornado.	Pulmonary Disease, Malarious Fevers, Dysentery.	Pulmonary Diseases, Malarious Fevers.	Malarious Fevers, Chronic Rheumatism, Guinea-worm, Pulmonary Diseases.	Diarrhœa, Dyspepsia, slight Febrile Attacks.	Dysentery and Diarrhœa, slight Feverishness.	Diarrhœa and Dysentery, Hepatic and Splenic Diseases.
December, .	Mild, soft, cold, bracing, and agreeable.	Cold, soft, tonic, bracing, soothing, and genial.	Mild, genial, soft, and bracing.	Malarious Fevers, Exanthemata, Dysentery, and Diarrhœa.	Dysentery and Diarrhœa, Exanthemata, Ulcerations, Rheumatism, Menorrhagia.	Congestive Fevers, Hepatic and Splenic Diseases.	Pulmonary Diseases, Glandular Swellings, Chapped Lip, Ophthalmia.	Pulmonary Diseases, Glandular Swellings, Ophthalmia, Hepatic Diseases, Chapped Lip.	Guinea-worm, Influenza, Glandular Swellings.

II.—TABLE OF METEOROLOGICAL OBSERVATIONS ON THE WEST COAST OF AFRICA. (*By the Author.*)

MONTHS.	The Mean Thermometer.									Mean Dew-point.				Mean Hygrometer.			Mean Saturation of the Atmosphere.			Mean Ozonometer.		Mean Barometer.		
	Gold Coast.			St Mary's, Gambia.			M'Carthy's Island; Gambia.			Gold Coast.			Gambia.	Gold Coast.			Gold Coast.			Gold Coast.		Gold Coast.		
	Morning.	Noon.	Evening.	Morning.	Noon.	Evening.	Morning.	Noon.	Evening.	Morning.	Noon.	Evening.	Mean Monthly.	Morning.	Noon.	Evening.	Morning.	Noon.	Evening.	Day.	Night.	Morning.	Noon.	Evening.
Jan.	76·5	81	78	...	...	...	69	81·5	90	69	65·5	78	64·05	6·2	9·35	6·10	729·7	607·8	770·8	...	...	30·86	30·87	30·86
Feb.	81	87	82·5	81·5	...	...	74	92	96·5	76·5	75·5	74·5	60·0	5·2	8·5	6·22	800·6	801·3	796·6	5·2	7	...	...	...
Mar.	82·5	86	83	82·5	84·5	84	77·5	95	99	77	76	77	56·5	5	8·4	6·6	853·8	731·3	842·3	5	6·05	...	...	...
April	81·5	86	85	79·5	74·5	84	81	93	104	75	77	77·27	61·10	4·0	6	6	840·0	802·9	825·8	3·9	4·2	...	...	...
May	78·5	83	81	79·5	74·5	79·5	84	97	103·5	74·5	76·2	75·5	60·6	3	6·5	6·0	885·0	776·4	801·9	4·9	4·4	...	...	...
June	77	80·1	78	79·5	83·5	79·5	80·5	90·5	96·5	74	74·2	73	65·9	3	5·7	4·5	862·3	799·0	801·3	3·7	4·2	...	...	...
July	76·5	80	78	79·5	79·5	79·5	80	87	84·5	73	72	72	...	2·6	6	5	872·5	776·1	812·3	4·3	7·6	...	...	...
Aug.	74·5	79	75	79·5	79·5	79·5	79·5	84	86	71·20	72	71·15	...	2·5	5·5	3	854·8	784·7	866·5	1·6	3·4	...	...	...
Sept.	74	78	74	...	...	...	80	85	87	70·5	70·5	71	...	3	4	2·5	886·0	837·4	894·4	1·8	4·05	...	...	...
Oct.	77·5	79	77	...	...	...	85	86	88	73·5	72	72	...	3·5	5	3·7	851·6	810·3	861·6	7·05	7·6	...	...	...
Nov.	78·25	83	77	...	...	...	77·5	87	90	73	73·5	74	...	4·6	5·8	4·2	828·9	759·8	834·3	...	...	30·71	30·74	30·75
Dec.	78·5	82	83	...	...	...	70	82	81·5	73·5	74	77	...	3·7	5·8	4·8	831·9	772·2	808·3	7·6	8·8	30·65	30·69	30·69

III.—TABLE OF METEOROLOGICAL OBSERVATIONS ON THE WEST COAST OF AFRICA. (*By the Author.*)

MONTHS.	Monthly Range of Temperature.			Monthly Range of Dew-Point.		Average Monthly Thermometer.						Number of Fair Days.			Number of Rainy Nights and Days.						Cloudy Days.	Mac-Carthy's Island.
						River Gambia, M'Carthy's Island.									Gold Coast.		Sierra Leone.	Gambia.			Gold Coast.	
						1864.			1865.									St Mary's.	Mac-Carthy's.	Mac-Carthy's.		
	Sierra Leone.	Gambia.	Gold Coast.	Gambia.	Gold Coast.	Morning.	Noon.	Evening.	Morning	Noon.	Evening.	Sierra Leone.	Gambia.	Gold Coast.	No. of Days Rain fell.	No. of Nights Rain fell.	No. of Days and Nights Rain fell.	No. of Days and Nights Rain fell.	No. of Days and Nights Rain fell.	No. of Days and Nights Rain fell.	No. of Cloudy Days.	Mean Monthly Temperature 1865.
	1860	1866	1859–60	1866	1859–60							1860	1866	1859–60	1859–60	1859–60	1860	1866	1864	1865	1859–60	
Jan.	...	40	10	12·1	17	70·6	86·8	83·9	70·6	86·5	91·7	...	31	31	1	1	...	...	...	1	3	82·9
Feb.	...	39	12	17·4	21	73·2	87·4	90·8	75·1	91·7	94·5	...	29	20	2	1	...	...	3	...	7	86·7
Mar.	...	48	9	11·4	8	75·2	84·7	98·3	77·8	95·3	99·0	...	31	15	3	2	...	...	...	...	15	88·4
April	7	48	10	17·8	10	79·7	93·5	100·3	81·6	98·0	102·5	...	30	17	4	4	...	...	1	...	9	92·08
May	18	39	11	8·5	7	79·3	95·7	100·9	83·6	96·9	103·5	...	29	21	3	7	...	2	1	1	8	93·58
June	17	39	10	17·1	8	82·3	91·6	92·5	81·8	92·1	98·04	...	29	15	4	5	...	1	9	9	11	90·13
July	...	39	9	...	5	80·9	90·8	90·0	80·6	87·5	90·06	...	18	12	6	6	...	13	15	15	13	85·35
Aug.	11	39	10	...	4	79·3	83·5	86·3	79·4	85·5	87·06	6	11	24	...	...	25	20	22	19	6	83·25
Sept.	15	46	7	...	6	79·2	80·1	92·7	79·8	86·6	88·6	5	17	20	2	10	26	14	8	11	9	84·21
Oct.	23	...	7	...	8	79·5	89·0	92·0	79·1	87·4	90·6	7	...	25	3	7	23	...	5	5	2	84·89
Nov.	...	...	11	...	8	77·4	89·0	86·1	75·3	86·8	90·63	...	...	24	3	8	...	...	...	1	2	82·96
Dec.	...	...	7	...	5	70·4	87·3	90·4	69·0	81·5	86·06	...	...	29	...	2	...	...	...	...	2	77·5

IV.—Table of Meteorological Observations on the West Coast of Africa. (*By the Author.*)

Months.	Maximum Thermometer.				Minimum Thermometer.			
	Sierra Leone.	Gambia. St Mary's.	Gambia. M'Carthy's Island.	Gold Coast and Bights.	Sierra Leone.	Gambia. St Mary's.	Gambia. M'Carthy's Island.	Gold Coast and Bights.
January, . .	80	99·5	98	83	79	59*	64	76
February, . .	87	101	102	90	80	62	65	78
March, . . .	86	108	104	89	79	60	72	80
April, . . .	84	108	110	89	79	60	76	83
May, . . .	85	99	108	86	79	60	80	75
June, . . .	80	99	106	84	78	60	76	74
July, . . .	84	99	98	83	78	60	75	74
August, . .	82	99	92	83	75	60	76	73
September, .	83	106	94	79	78	60	77	72
October, . .	83	...	94	83	78	...	75	75
November, .	83	...	94	86	79	...	71	77
December, .	85	...	91	83	77	...	64	76·5

In the above summary the observations in Sierra Leone must be regarded, as yet, as incomplete. I have not had the advantage of being stationed for military duties at Freetown, or I should, from personal investigation, and researches in the records of the colony, have been able to gather sufficient interesting information on the points under consideration; but I hope I shall be able in time to do so.

Mean Monthly Temperature at M'Carthy's Island for 1865.

Months.	Mean Temperature.	Months.	Mean Temperature.
January. . .	82·9	July, . . .	85·35
February, .	86·7	August, . .	83·25
March, . .	88·4	September, .	84·21
April, . .	92·08	October, . .	84·89
May, . . .	93·58	November, .	82·96
June, . . .	90·13	December, .	77·5

* This is the result of the minimum thermometer; the others the result of the ordinary thermometer.

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